MECHANICAL ENGINEERING

· MARCH 1949 ·

Departments

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 71 · NUMBER 3

Contents for March, 1949

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $7.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters three weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Member of the Audit Bureau of Circulations.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

Cadet Training Ship "Eagle"—U. S. Coast Guard Academy, New London, Conn.

(See page 273 of this issue for story of ASME Spring Meeting at New London, May 2–4, 1949.)

VOLUME 71
No. 3

MECHANICAL ENGINEERING

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GEORGE A. STETSON, *Editor*

Increasing Membership

A CHART showing the growth of membership in engineering societies in the United States from 1880 and comment on it will be found in the February, 1949, issue of *The Technology Review*. Plotted on this chart are the membership curves of the four Founder Societies, the Society of Naval Architects and Marine Engineers, Society of Automotive Engineers, American Institute of Chemical Engineers, and the Institute of Radio Engineers. Additional curves show the combined membership of these organizations and the population of the United States.

Some interesting characteristics of these curves can be noted. For example, only during the depression of the thirties did the total membership suffer any decline. During that period only the A.I.Ch.E. showed steady upward progress. In general, growth has been more rapid in the younger societies than in the older ones. The curves of five of the societies are today clustering around the twenty to twenty-five thousand mark; all are at their all-time highs.

Commenting on the total membership and U. S. population curves the *Technology* article says: "In 1880 there was one member of an engineering society for every 30,800 of population. By the turn of the century the proportion of engineers had grown to one for each 8900 persons. Shortly after World War I there was one engineer for each 2120 persons, and the present figure is something like one out of 910 persons. If the present trend continues there will be one member of a major engineeering society for every 795 persons in this country by 1950."

Put in this dramatic way the figures are likely to astonish the average engineer. Of course there are duplications in the memberships of the societies, but there are dozens of other engineering societies which are not included. And it is well known that many engineers belong to none of the major societies. It must be concluded, therefore, that the ratio of engineers to total population is more likely to be on the low than on the high side.

Another figure that usually astounds the ASME member is the number of members of the ASME student branches. At present this figure stands at 18,600 and compares with a total membership in other grades of 27,000. Of course not all of these students are in the graduating class and not all will become junior members upon graduation. For example, out of a graduating class of 4752 in 1947 about 2800 transferred to junior membership. It is apparent, therefore, that unless an economic upheaval of the character experienced in the depression of the thirties intervenes, growth of ASME membership will continue to be upward.

No one even remotely familiar with the development of technology, industry, and economic patterns during the last hundred years will be astonished at the increasing ratio of engineers to total population in the United States. Prediction as to when the saturation point will be reached will not be attempted here because too many factors are involved. One factor, which will probably be affected by decisions of engineers themselves, is the definition of the engineer and more stringent minimum qualifications for membership.

It is a distressing fact that in spite of large memberships engineering societies find it difficult to balance their budgets. ASME is probably more fortunate in this respect than many others, although its recent additions to surplus have been shrinking. The reasons for the situation in which engineering societies find themselves are fairly obvious. Membership dues have not been increased and attempts by some societies to do so have not been successful. On the other hand salaries and prices have reflected the inflationary tendency of the times. Moreover, the number of activities in which engineering societies engage have increased. To meet the gap between dues income and total expenses, engineering societies have effected economies in traditional practices that were wasteful and have found sources of income in publications and other fields. There can be little doubt that growth of membership is not in itself the means by which the income of engineering societies will be made to cover its expenses and that the trend will be in the direction of securing additional income from the activities in which the societies engage. Increase in membership enhances prestige and influence of the societies. It provides greater reservoirs of talent. It infuses new blood and the virility and industry of youth into the organizations. It enriches the value of the services and enlarges the opportunities for services to industry, to the profession, and to the public. It develops more fruitful markets for income-producing services. It permits more diversified programs. It makes possible a more widespread cross-fertilization of knowledge throughout the engineering profession.

In more ways than in the number of their members engineering societies are today at a high point in their careers. They enjoy a growing prestige and exert powerful influences. But they face critical times. If they are not to deteriorate they must have superior leadership and wholehearted support. They must continue to exercise their ingenuity and sound business judgment in developing sources of income to finance their activities. The break with the traditional pattern of support almost

solely from members' dues, which began some years ago and has been widening ever since, must necessarily continue. ASME has made considerable progress in this direction but it must be prepared to go even further in the future if it is to continue to serve an increasing membership.

Publications Review

TWO years have passed since the Publications Committee of The American Society of Mechanical Engineers entered the final phase of its intensive study of Society publications that resulted in a proposal to adopt a new procedure. The new plan, as it was called, was submitted to the members for letter ballot late in the summer of 1947 and was approved by a vote of approximately eight to one. At the 1947 Annual Meeting the Council approved the plan and ordered it put into effect on Jan. 1, 1948, which was done. At that time it was decided to give the plan a full year's trial and to review it early in 1949. Such a review is now in progress.

What the Committee hoped to accomplish under the new plan can be summarized briefly: To improve the technical quality of the publications; to reduce delays in bringing technical papers to the attention of members; to provide in MECHANICAL ENGINEERING a means by which all papers could be brought to the attention of members; to reduce publication expense; and to reduce waste.

Opinions will differ as to how successful the Committee has been in improving quality. Under the new plan, in theory at least, a fairly complete preprint service makes almost every paper available to members who may find it of interest. The periodical publications can therefore be reserved for papers which, in the opinion of reviewers and the Committee, are of highest quality, of broadest appeal, or of most permanent value.

One of the most important features of the plan was the addition to MECHANICAL ENGINEERING of a new department, known as "ASME Technical Digest," in which digests of papers to be presented at meetings, or actually presented at recent meetings, are printed. Copies of papers noted in the Digest section are available and may be purchased of the ASME Publication Sales Department. When papers are submitted well in advance of meetings, preprints can be provided so that the digests are printed before the meeting is held. If a paper is received late, the digest cannot be printed until after the meeting. The Committee hopes to encourage early submission of papers so that a greater number of digests can be printed in advance of meetings. Until the Digest section was instituted the members who did not attend a meeting seldom knew about the papers presented until they appeared in the periodical publications some six to nine months after presentation. Under the current plan the member who keeps abreast of the Digest section can buy preprint copies many months before final publication, and he can also buy copies of papers which may be of value to him but which, for one reason or another, are never published in full in the periodical publications. It can now be said that every meeting paper of which the Society has a manuscript can be found in MECHANICAL ENGINEERING in full, in condensed form, or in digest form. In 1948 the twelve issues of MECHANICAL ENGINEERING contained 272 digests, and 17 papers were used in the "Briefing the Record" section in condensed form. Many other papers appeared in full.

Reduction of publication expense was a prime objective of the new plan. The attempt was made to relieve the Society as a whole of as much of the expense as possible and to require members who desired the Transactions, the *Journal of Applied Mechanics*, and preprints of papers to pay something for them. Hence the radical steps were taken of placing Transactions and the *Journal of Applied Mechanics* on a subscription basis and charging a nominal fee for preprints. A further advantage of the scheme was the reduction of waste of publications and preprints. A year's experience has produced the following results: The production expense (printing, paper, illustrations, and the like) of Transactions and the *Journal of Applied Mechanics* has been cut in half and a worth while income from subscriptions has been built up. Income from sale of "preprints" has more than covered material and manufacturing expense. It is only fair to point out that the reduction in expense and increase in income do not represent net gains to the Society because of the new Digest service and the increased clerical staff of the Publication Sales Department. Actually, the number of text pages printed in MECHANICAL ENGINEERING in 1948 was almost the same as the number printed in 1947. If the savings under the new plan had not materialized or if the Society had operated its periodical publications in 1948 under the old plan, sharply increased printing rates would have demanded a reduction in the number of pages printed. When all factors are considered it can be shown that the net saving in publication expense and the net income are considerable and have benefited the Society financially.

In the review which the Publications Committee is undertaking consideration is being given to objections to the new plan and suggested modifications of it that have come from members. These objections and proposals group themselves into a relatively few categories. A considerable number of the proposals, if adopted, would increase expense to the Society. Objections are based principally on hardship to individual members, particularly to young members and those who make considerable use of technical papers, because Transactions and the *Journal of Applied Mechanics* have been placed on a subscription basis and because "preprints" of papers must now be purchased. Other objections are based on the "inconvenience" of the preprint procedure and the coupon scheme.

It would be premature to predict what recommendations the Publications Committee will advance as a result of the study of a year's experience with the new publication plan. There is no doubt that inconveniences of the preprint procedure, which it was difficult or impossible to foresee, will be alleviated. The Committee is tackling its present task with the best interests of the Society and its members in mind.

ROCKETS *as* RESEARCH TOOLS *in* AERONAUTICS

By HUGH L. DRYDEN

DIRECTOR OF AERONAUTICAL RESEARCH, NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, WASHINGTON, D. C. MEMBER ASME

ONE of the important developments of World War II was the application of rockets as military weapons, which led to an active development program on rocket propulsion. The most impressive rocket weapon was, of course, the 12-ton V-2 rocket, the result of scientific and engineering activities dating back to 1934. The place of rocket propulsion in projectiles and missiles is now well established.

Since the war other applications of rockets have been made, and it is with three of these that I wish to treat briefly. All three involve the use of rockets as research tools in aeronautics. The three applications are: To the propulsion of models in free flight for aerodynamic measurements at high speeds; to the propulsion of piloted research aircraft; and to the sounding of the upper atmosphere.

PENETRATING THE SONIC BARRIER

The development of jet propulsion completely revolutionized the art of aircraft design and made possible a great advance in the performance of aircraft, especially as regards speed. In particular, aircraft speeds almost immediately entered the so-called transonic or mixed-flow region in which the air flow begins to change from the subsonic to the supersonic type. For years it had been supposed that aircraft could not penetrate beyond a "sonic barrier," the region where the drag of the aircraft increased disproportionately. Early experience with the severe trim changes and large stick forces encountered as the speed was increased led to the picture of the transonic region as a region to be avoided or hurriedly traversed. The flight of the Bell X-1 to supersonic speeds has modified this concept. In particular, a look at the quantitative information obtained led to the exercise of engineering ingenuity to find methods of dealing with or minimizing the difficulties encountered. As is always the case, knowledge dissipated fear. The pendulum has now swung. Designers are clamoring for specific information on aerodynamic and propulsion characteristics of all possible configurations at transonic speeds so that practical aircraft can be built to fly in and through this region.

The NACA and other research agencies anticipated this need by a few years and undertook to develop techniques for research in this field. Unfortunately, wind tunnels, the most useful research tools at subsonic speeds, have limitations at speeds at and near the speed of sound because the passage chokes, blocking further speed increase when the speed at the narrowest cross section reaches the speed of sound. There is a blind spot whose width is dependent on the size of model and on its shape.

One of the early techniques was to drop heavily weighted models from an aircraft at high altitude. If the weight per unit frontal area is sufficiently great, speeds up to and slightly exceeding the speed of sound can be obtained. By telemetering accelerometer readings and by radar tracking the drag can be measured.

Another of the earliest techniques, the wing-flow method, was developed by R. Gilruth and his co-workers at the NACA Langley Aeronautical Laboratory. Gilruth took note of the increase in local air speed above the curved upper surface of an airplane wing in flight. The local speed may be one and one-half or more times the flight speed so that there is a region near the wing of an airplane flying at 0.7 the speed of sound where the local speed exceeds the speed of sound. While there are speed gradients present, the speed is approximately uniform over a region of sufficient size to include a small scale model. Gilruth mounted small models on a balance built into the upper surface of a fighter airplane which could be dived at high speed. While the models are small and the conditions not ideal, for a time this and the dropped-body technique were the only methods of study in the transonic region. The method yielded information of great value and is still useful.

Shortly after the wing-flow method was in use, the same general principle was applied to wind tunnels by the Lockheed Company in the GALCIT Cooperative Wind Tunnel and by the NACA in the Langley 7 × 10-ft wind tunnel. The local transonic region was created by installing a "bump" on the wall of the wind tunnel, hence the name "bump method."

ROCKET-PROPELLED RESEARCH MODELS

These methods have now been supplemented by another method, the rocket-propelled model, made possible by the general availability of rockets. In 1945 the NACA established a field test station for this purpose at Wallops Island, Va., on the Atlantic Coast south of the Naval Ordnance Test Station at Chincoteague. The information obtained by this method has been found so useful to aircraft designers that the station has continued to grow, and a committee of aircraft designers recommended recently that its activities be increased threefold.

The research models are propelled by standard rocket motors rebuilt to specifications of size and performance suitable for the particular aerodynamic models they propel. Much of the work has been done with standard $3^1/_2$ and 5-in. solid-propellant rockets used by the military services to propel explosive charges. The rockets are modified by changes in the nozzle and igniter to give the desired thrust and operating time and by adding tail pipes as needed. Often two rockets are used in sequence as booster and sustainer.

The simplest type of research model is that used for measurements of drag at zero lift. This model consists of a standard rocket placed inside a light wooden body or fuselage which may or may not carry wings, fins, or wings and tail of the configurations to be studied. The model itself contains no instrumentation. A typical drag model is about 5 in. diam, 56 in. long, and weighs 35 to 45 lb at firing. With a second booster rocket, a speed of about 1.9 times the speed of sound is reached, without it about 1.2 to 1.5 times the speed of sound, depending upon the weight. The distance from the

Address contributed by the Aviation Division and presented at a dinner of the American Rocket Society in conjunction with the Annual Meeting, New York, N. Y., November 28–December 3, 1948, of The American Society of Mechanical Engineers.

ground station to the rocket is recorded by means of a Doppler radar, and from the record the speed and acceleration or deceleration can be determined accurately. The drag is determined from the deceleration of the missile after the rocket has burned out. The effects of wing planform, thickness, and aspect ratio have been determined for many configurations, including sweptback and triangular wings.

A less simple model is used to measure control surface effectiveness. This model carries a small radio transmitter which transmits a continuous signal from an antenna which has marked directional characteristics, this instrumentation occupying the nose. These models are somewhat heavier than the drag models, weighing 100 to 120 lb. The wings are equipped with trailing-edge flaps which are deflected in opposite directions on the two sides, thus causing the model to spin. Because of the directional characteristics of the antenna, the signal received on the ground fluctuates in intensity, the number of fluctuations per second corresponding to the rate of rotation, which is a measure of control effectiveness. In some instances, the spin is observed to slow down and change sign as the speed is increased or decreased through a certain range. Such a result indicates a reversal of control effectiveness in certain speed ranges for that type of control-surface design.

Other missiles carry more complex instrumentation and permit other types of measurement. Telemetering is used to transmit the measurements to the ground. Longitudinal acceleration, lateral acceleration, impact pressure, control-surface position, and hinge moments of control surfaces are some of the quantities which can be measured. Programming devices may be used to oscillate the control surfaces or to displace them suddenly and repeatedly. By such methods, information can be obtained about longitudinal and lateral stability, damping and period of oscillations, effectiveness of controls, pressure distribution, and similar aerodynamic characteristics as a function of speed through the transonic region. The models may represent the configurations of piloted aircraft or missiles intended to be constructed.

Rocket-propelled models may be used for many other special investigations, for example, the study of wing flutter and the study of aerodynamic heating. An important problem under study by this method is that of pilot escape from transonic and supersonic aircraft. The nose section containing the cockpit may be released at high speed, and its motion and acceleration telemetered to the ground. The techniques are constantly being developed to permit the study of many of the new problems of high-speed flight.

ROCKET MOTORS FOR AIRCRAFT

The second application of rockets is to the propulsion of piloted aircraft, specifically to the research airplanes. The concept of building a special research airplane for the sole purpose of making quantitative measurements at very high speeds arose, probably in many minds, in the year 1944. The proposal was vigorously advocated by John Stack and discussed within the NACA staff and the NACA Aerodynamics Committee. Within a year the military services were engaged in receiving proposals, and a co-ordinated program was arranged, involving the study of conventional and sweptback wings of two thicknesses and the use of turbojet and rocket power. The Navy sponsored the Douglas D-558 series, the Air Force the Bell X-1 series. The D-558 early captured the speed record, since exceeded by the F-86, and the X-1 was flown faster than sound. Striking as these performances are, these accomplishments were but incidental to the chief purpose and are not nearly so significant as the quantitative data already obtained and those now being obtained on drag, stability, trim changes, air loads, and the like, at all speeds within the capabilities of the aircraft.

There are many misconceptions about the X-1. It is not a tactically useful airplane; it was designed for 500 lb of instruments, strength to withstand a load of 18 times its weight; it was kept small so that control forces could be kept within the capabilities of the pilot; and it can fly at full power for only a few minutes. Its aerodynamic design was not regarded as optimum for supersonic speeds; it was built to verify results obtained by other methods and to further study the behavior of conventional configurations. Only a rocket could furnish sufficient thrust to drive this configuration at supersonic speeds and then only at very high altitudes where the drag is reduced because of the reduced air density. It seems unlikely that rocket engines will be used as the main power plant of useful piloted aircraft because of the tremendous fuel consumption, although they will probably be used as auxiliary power plants for take-off and combat.

BRIEF DETAILS OF ROCKET ENGINE

The rocket engine is Reaction Motors RMI-6000C4, having a total thrust of 6000 lb with an engine weight of 210 lb. The X-1 carries 8177 lb of fuel (61 per cent of the gross weight of the airplane) which at full power is consumed in 2.5 min (54 lb per sec). The engine uses alcohol and liquid oxygen which are forced through the supply nozzles by the pressure from compressed nitrogen gas.

The engine consists of four separate chambers grouped into a single unit. By this means the pilot may select a thrust of 1500, 3000, 4500, or 6000 lb at will. He may also turn any tube on or off at will and thus has a 4-step control until the fuel is exhausted. The chamber pressure is 230 psi, and the combustion temperature is about 5000 deg R. To cool the chamber the alcohol fuel is mixed with about 25 per cent water and circulated through a cooling jacket around the nozzle before passing to the combustion chamber. Addition of the water is said to have only a slight effect on the thrust.

The first flight of the XS-1 with this rocket engine was made on December 9, 1946, a Mach number of 0.79 being reached at 35,000 ft with half power. Since then the airplane has made many flights in the hands of several pilots.

Other research airplanes will use rocket engines as auxiliary power plants to enable the attainment of still higher speeds. I should like to emphasize again that the interest is not in speed records but in research data throughout the speed range. The engineer is concerned with that region within which large changes in characteristics occur, which is different for different airplanes in the series. The expected phenomena are known to some extent from wind-tunnel data, dropped-body tests, wing-flow tests, and rocket-propelled-model measurements. Research airplanes provide the final check and give confidence to designers to proceed with practically useful aircraft capable of flight in the transonic and supersonic regions.

SOUNDING ROCKETS

A third application of rockets as research tools in aeronautics is to the study of conditions in the upper atmosphere. Interest in the upper atmosphere arises from many sources, for the conditions there have a profound influence on human affairs. Astronomers have been annoyed with the interference of the atmosphere in their observations, for even in the absence of clouds an ozone curtain shuts off a view of the short-wave-length end of the spectrum of stars and sun and so denies them some information on the constitution and physical state of the heavenly bodies. Ordinarily men are thankful for the existence of the curtain because it protects them from the harmful

(*Continued on page 231*)

Report to the
U.S. ATOMIC ENERGY COMMISSION

By the Industrial Advisory Group[1]

INTRODUCTION

THE Industrial Advisory Group, established by the Atomic Energy Commission as an advisory board under Section 12(*a*) of the McMahon Act of 1946 was requested to survey the Commission's activities and make recommendations for increasing industrial participation in the atomic-energy project. Specifically, the Group was asked to help the Commission in developing a program with the following purposes:

1 Utilize fully the Nation's industrial research and development capacity;

2 Keep the industries directly concerned fully informed as to the developments in their fields; and

3 Insure opportunities for technical training in atomic energy of as large a part of American industry as possible to prepare the industrial community of the Nation for the job it must do if America is to be strong in atomic energy.

The Commission announced the plan for the Industrial Advisory Group on Oct. 6, 1947. It assembled most of the members of the committee for a first meeting with the Commission on Oct. 20, 1947. The full organization of the Group, with all members designated, was completed early in November of 1947.

Two of the original members of the Industrial Advisory Group found it necessary to withdraw before the completion of our assignment. Mr. Donald F. Carpenter resigned to take the post of chairman of the Military Liaison Committee under the Atomic Energy Act. Dr. Oliver E. Buckley resigned to accept a presidential appointment to membership on the General Advisory Committee under the same law. Up to the time of resignation, theirs were among the most significant contributions to our work. We have felt their loss keenly.

Members of the staff of the Atomic Energy Commission met with our Group on numerous occasions and accompanied us on our trips to the Commission's plants and laboratories. They were unfailingly helpful and facilitated our work at every stage. All of our Group appreciate their assistance and the many courtesies they extended us.

At the beginning of our assignment, the Commission suggested that Mr. Walker L. Cisler, executive vice-president of The Detroit Edison Company, who previously had been a consultant to the Commission on a number of its problems, might be helpful to us in our introduction to the subject. To this task Mr. Cisler brought an extensive background of experience both in industry and in government. He has, in fact, worked with us closely throughout the conduct of our survey, and our problems have repeatedly been illuminated by his insight.

In the course of our work we met with members of the Commission and its staff in Washington and elsewhere throughout the country, with its General Advisory Committee, with its Patent Advisory Panel, with representatives of concerns now or formerly engaged in work for the Commission or the Manhattan Engineer District, with other companies interested in atomic work, and with the Military Liaison Committee and other representatives of the armed services. Members of the Group also visited many of the plants, laboratories, and offices of the Commission.

On June 3, 1948, the Group reached certain conclusions and tentative recommendations which formed the basis for further discussions with the Commission and its staff during the past summer. These discussions were most helpful in clarifying and formulating this report.

The Commission has given us access freely to all necessary documents, personnel, and installations. In reaching our conclusions, we have taken full account of much secret information about the project, but we have found it possible to avoid detailed reference to such matters in our report. We have endeavored to prepare this report as a nonsecret document so that the Commission will be able to use it more conveniently, without the restrictions which surround classified material.

We emphasize this at the outset because, despite the excellent co-operation afforded by the Commission, one of the serious obstacles in making our survey arose out of burdensome security regulations. Difficulties in connection with clearances, the complicated mechanics of arranging for access to people and installations, the elaborate procedures for the safekeeping of notes and documents, as well as other secrecy restrictions, together constitute a formidable impediment to any attempt to study and understand the enterprise.

We mention this circumstance not at all as a criticism of necessary security policies, but because the need for secrecy creates a fundamental unsolved problem in dealing with the subject. It represents a troublesome factor in any attempt to broaden industry's role in the atomic-energy program.

At present the barriers to increased industrial participation, caused by secrecy and other fundamental difficulties, cannot be removed. But we believe, as will appear presently, that the Government can reduce the barriers and help the industrialist to cope with the difficulties. The Industrial Advisory Group is unable to suggest any simple formula that the Government might adopt to this end. In our opinion, however, adoption of the recommendations which are discussed in this report would lead in the right direction.

While our suggestions appear modest in comparison with the magnitude of the problems, it is important to observe, nevertheless, that most of the things we propose are not now being done on a broad and intensive basis. We believe that if our recommendations in this respect are followed and a program to that end is developed and vigorously pushed, both the Commission and American industry can look forward in the not distant future to a significant expansion of industrial participation in atomic-energy development.

1 PRESENT ROLE OF INDUSTRY IN ATOMIC ENERGY

In certain respects industry already has an important part in the atomic-energy program. Under the contract method of operation, initiated by the Manhattan Engineer District and strengthened by the Commission, most of the project's work is

[1] The Industrial Advisory Group consists of James W. Parker, chairman, Bruce K. Brown, Gustav Egloff, Paul D. Foote, Isaac Harter, Sr., Jerome C. Hunsaker, Gabriel O. Wesenauer, and Robert E. Wilson. Report submitted Dec. 15, 1948.

carried on through contract and subcontract arrangements with private firms and research institutions. The number of people engaged by private employers exclusively in the work of the Commission exceeds sixty thousand.

Generally speaking it is the Commission's policy to limit its own role to policy-making and program functions. Industrial concerns, under contract with the Commission, operate the production plants which make fissionable material at Oak Ridge and Hanford. They also conduct the Commission's research and development work at these locations and at Schenectady. An industrial concern operates the important Commission project at Dayton. The procurement and refining of raw materials and the research associated with these activities are likewise for the most part business enterprises. In somewhat the same way, the procurement of supplies and equipment and the Commission's vast construction program are carried on by industrial concerns. The huge Brookhaven National Laboratory on Long Island, the Argonne National Laboratory in Chicago, and others at Berkeley, Calif., and Ames, Ia., on the other hand are operated under contract with large universities.

In only one important area, nevertheless, is there any independent industrial activity. Radioactive and stable isotopes which the Commission is making readily available, on short notice, in reasonable quantities and at reasonable prices, are being used increasingly for industrial research and metallurgy. Their importance in helping to reveal new knowledge would be hard to overestimate.

Radioactive materials, supplied by the Commission, are also beginning to be used for industrial controls, although developments here are in a very early stage. It is not unlikely that in time to come their use in automatic control of chemical, metallurgical, and other processes will prove to be one of the most significant industrial values to come out of atomic energy.

Under the policies which the Commission is following, industry can also develop important activities in the manufacture of compounds from isotopes supplied by Commission plants. Industry is already engaged in the production of the equipment, materials, and services needed by the many tracer laboratories.

As the Commission says in its recent report on the subject, the potential application of isotopes to the work of industry is an open field of opportunity. Unfortunately, it is the only important open field in connection with atomic energy.

It was not within our Group's terms of reference to attempt to appraise the soundness of the general policies of the Atomic Energy Commission or the efficiency of its administration except as these matters have a bearing on our specific assignment. We have been in general favorably impressed with the energy with which the Commission has attacked its vital problem, with its practice of conducting work through private contract rather than by building up a Government force, with the effectiveness of its program to make isotopes freely available, and have been impressed, moreover, with the evident progress along many different lines of activity.

But our study confirms the judgment of the Commission which led to the setting-up of this advisory group: there is an unmistakable need for greatly expanded participation by industry in atomic-energy development. We recognize, of course, that in this new field of technology it is difficult to predict precisely which of the many American industries will have a direct interest in developments. But it is certainly true that some of the most important branches of industry are likely to have a direct potential concern with atomic energy. Among these are the chemical, petroleum, power, heat-transfer equipment, metallurgical, and instrument industries. And our observations during the past months bear out the warning of the Chairman of the Commission at the time the Industrial Advisory Group was set up:

Unless the initiative, the technical skills, and the managerial ability of American industry are brought to bear with maximum effect on the problems of atomic energy development (said Mr. Lilienthal), the people of the United States will not realize the full benefits of this new field of endeavor. . . . It is the purpose of the Atomic Energy Commission, and I have no doubt that it is the intention of the Congress, to move away from the present Government monopoly, provided by law, just as fast as it can be done with due regard for the national security. . . .

When I say there must be the greatest possible industrial participation, I mean not only the contract operation of facilities, to which the industrial skills of the country are already applied. And I mean more than the supplying of services and equipment. We do have more than 3000 contractors and subcontractors and major suppliers taking part in the program and this number will be increased.

We must find opportunities for industrial participation—that is, opportunities for profit. We must develop incentives to industry to get into this field. We must carry on a program which will encourage in atomic energy the same kind of competitive effort which has made the automobile and chemical industries what they are today, that competitive effort which keeps all American industry pushing at the frontiers of technology.

2 NEED FOR INCREASED PARTICIPATION AND MAJOR OBSTACLES THERETO

The difficulty and the danger in the present situation is that industry's part in atomic energy is very limited as compared with the opportunities which exist and always have existed in other fields. The small number of companies which take significant part are selected by the Government and the extent of their role in the work is limited by specific assignments from the Government.

This condition is unfortunate not only because it runs counter to the conviction widely held to in America that opportunities for the exercise of enterprise, initiative, and ingenuity on a broad scale are essential to national well-being; there is also another and pressing reason for broadening industrial participation. The Commission is faced with a multitude of new technical problems which need to be solved promptly in the interest of national security. These are the very kinds of problems which our industrial system has in the past shown itself to be pre-eminently qualified to solve.

The Commission, for example, is seeking improved methods for finding, refining, and utilizing its basic raw materials. It is seeking improved methods for producing fissionable materials. It is seeking to develop new reactors that will produce power and "breed" more atomic fuel than they use up. Progress in atomic developments—for military as well as peaceful purposes—depends on getting answers to questions of extreme difficulty in physics, chemistry, geology, engineering, and metallurgy.

Success in finding solutions for comparable problems in other fields of technology has come about through energetic attack by many competing firms and individuals rather than by any select group. The Commission's contract system—though it includes some of the country's ablest industrial organizations—is not by itself a real substitute for this process.

An illustration of the process in miniature can be observed in the experience of our own small group. In the course of our survey, we were consulted informally by the Commission or its contractors on problems with which they were confronted. One or another of our number, drawing upon his particular industrial background, was able more than once to suggest a helpful new approach toward solution. The suggestions reflected no superior talents but merely the fact that occasionally the specific background of certain individuals furnished a different clue from those discerned by the men already at work on the subject. The need, as Mr. Lilienthal has said, is to bring the resources of industry to bear on atomic energy with "maximum effect." This means that all those industries which are potentially interested must somehow become broadly and deeply in-

volved. The suggestions that a few industrialists may make on casual contact are obviously insignificant as compared with the possible contributions that all these industries could make if the opportunity were available to them.

The matter of industrial participation, of course, involves much more than getting help for the Commission in meeting its technical problems. There is also the hope that if industry once becomes engaged, it will discover for itself many lines of economically rewarding activities in this new field. Industrial experience with radio isotopes, the one open area, is already beginning to bear out this hope.

We think that today the central difficulty in getting a broad industrial attack on the problems of atomic energy is the fact that industry has no way of determining whether important opportunities in fact exist in which to take part. In our view it is a mistake to think that the seeming absence of conventional incentives to business is the main cause of the present situation. While the hope-of-profit motive may be the primary inducement to industry in entering new ventures, much more than the prospect of immediate profit is involved here. The expectation of financial reward even in the distant future—the desire for prestige, and for getting an early start in an important new field—these are often enough. A genuine concern for the Nation's defense would be sufficient inducement to some, regardless of the financial return.

It has been stated that industrial opportunities in atomic energy are potentially unlimited. But they are at present so shadowy that businessmen neither know where to look nor what to look for. Today no one can say whether the prospect of profits or other incentives exist, because under present conditions the great majority in industry know little or nothing about the subject.

The need for Government monopoly in certain important areas, coupled with secrecy, seems to erect an impenetrable barrier to a wish for knowledge. If industry is to help in atomic energy and benefit from it, industrialists must first be put in a position to find out enough about the subject to determine whether and where there are in fact opportunities to take part. In devising means to this end, only the Government can take the initiative. The Government, which must exercise a broad monopoly and determine security regulations, alone is in a position to open the doors. Industry can, and we are confident that it will, co-operate. But Government must first provide the catalytic forces that will set more of the normal processes of industry to work.

This the Government can do: (1) By providing industry with much useful information about atomic energy; (2) by greatly increasing direct personal contacts between men in industry and the atomic-energy project; (3) by setting up and making effective use of various kinds of industrial advisory committees; (4) by further strengthening the contract system and; (5) by perfecting the Commission's form of organization so that it will be in a better position to deal effectively with industry. The remainder of this report is taken up with a discussion of these measures.

3 ADDITIONAL REPORTS BY AND ABOUT THE COMMISSION

A good deal of information about the Commission's activities has appeared publicly in Commission reports, Congressional hearings, press releases, and articles in the technical journals. But usually the material is not organized or presented in a fashion that makes it really useful to industry. The task of digging the scattered and fragmentary material out of such sources and piecing it together—with understanding and in a usable, organized form—is well-nigh impossible for anyone except members of the Commission staff or groups working under the direction of the Commission.

Moreover, during our survey we received the distinct impression that a vast amount of nonsecret information about the work of the Commission and its predecessor, the Manhattan Engineer District, has never been published anywhere. This type of material can only be made available if the Commission devotes more effort to the task of sorting out the nonsecret from the secret for publication. Frequently this nonsecret information which has not yet been published anywhere is essential to a clear understanding of that which has already been published in some form.

We are aware of the Commission's efforts to develop a broad program for the dissemination of information about atomic energy. This program, which wisely places a heavy reliance on various types of publishing agencies outside the Government, is valuable and should be vigorously pursued. We think, nevertheless, that the efforts thus far have not been focused specifically enough on the problem of educating industry. Scientific information appears to be made available by the Commission in a manner adequate to keep interested scientists informed. But the availability of additional material—in a form useful to industry—is indispensable to getting industrial participation in atomic energy.

Industry requires information along two quite distinct lines. First, it needs much additional technical and semitechnical knowledge about the whole field of atomic energy. Such information will help in clarifying and identifying the opportunities which atomic energy potentially affords to industry.

There is a second class of knowledge which must be made available in order to complement the first: information about the structure of the Commission, its administrative policies and its procedures. The better industry is informed about these matters, the better it will be able to deal with the Commission with assurance and understanding. The general atmosphere of secrecy which surrounds atomic energy has enveloped this kind of information—even though most of it is nonsecret—almost as completely as technical matters.

Technical and Semitechnical Information. As an illustration, there is already a conspicuous example of the first type of informative action, in which the Commission has proceeded wisely. In our preliminary discussions with them last June, we stated our favorable impression of the Commission's radioisotope program, but expressed the opinion that the activity of industry would be speeded up if knowledge of what the Commission was doing were made more widely available.

We have been particularly gratified to observe that in the Commission's Fourth Semiannual Report dated July 31, 1948, a large part of the text is devoted to a well-organized and detailed semitechnical report on radioisotopes. The report, we think, is an excellent demonstration of how the Commission can help industry to recognize and take advantage of opportunities in atomic energy. We urge the Commission to continue the preparation and issuance of such reports and also separate reports on specific subjects which would supplement or be in addition to such reports as the Fourth Semiannual Report. These separate reports should be characterized by the same kind of discernment in anticipating the questions industry needs to have answered.

We recognize that the publication of Government reports on radio isotopes is much simpler than reports on other technical aspects of atomic energy. But it is precisely in these more secret and less advanced areas of development that it is essential for the Commission to make it possible for industry to become informed. Even as to these areas, we think there is much more that the Commission can do, within the limits of security, to inform industry.

During our survey of the project, we observed, for example, interesting and valuable new metallurgical techniques, new

chemical treatments to protect against corrosion, new plastics, instrumentation, and useful technical knowledge of many kinds. This information, although developed in research on atomic energy, is only incidentally related to atomic energy. It is still largely unknown except to those industrial organizations which actively participated in the research through which it was discovered.

We have the impression that for reasons which are not at all clear, much of this knowledge is still buried in the files and activities of the Commission. We think the Commission should make a special effort to publish it—to the extent that military security will permit—at the earliest possible date. The cost of secrecy is high. This is one of the many instances in which we have thought its value doubtful.

Another example of a technical subject on which additional information is needed was also mentioned in our earlier comments on the Commission's work. It was suggested that an engineering analysis of the economic conditions to be met in the production of power from atomic energy would be valuable. We suggested that this analysis might be made on behalf of the Commission by a large industrial organization acting under contract. Another and perhaps wiser approach would be to accept the offer of The American Society of Mechanical Engineers to make such an analysis for the Commission.

In renewing this suggestion, we do not mean to minimize the value of the statement on the subject of atomic power of the Commission's General Advisory Committee, which appeared in the Commission's Fourth Semiannual Report. The General Advisory Committee statement was useful. But we think that a detailed economic and engineering evaluation of heat energy from atomic fission should be possible without waiting for the development of practicable methods, and of course without violation of security. The study we have in mind would make a careful analysis of all the paths that look feasible for developing power for practical industrial application.

Information on the Commission's Structure, Administrative Policies, and Procedures. Within this category, there are many examples of topics that would be of special interest to businessmen. From a security standpoint, publications of this type should not present the difficulties which are inherent in those on more technical subjects.

The patent situation is a good illustration. In discussions with industry, our Group has frequently heard great concern expressed about patents. There is a strong impression that the Government's patent policy is prejudicial to industrial participation in atomic energy. Unless the Commission clarifies the situation, hesitancy may continue to affect industrial participation adversely.

A year ago the Commission published a first report, prepared by a distinguished Patent Advisory Panel, which treated the subject exhaustively. But the treatment in that report, however useful to the Commission, has not allayed industrial apprehension. The reason for this is not difficult to find. The purpose of that report, as stated by the Commission in releasing it was "to recommend policy, procedures, and staff organization implementing the patent provisions of the Atomic Energy Act of 1946." In other words, the report was prepared not for the education of industry, but for the guidance of the Commission. It has undoubtedly served that stated purpose very well. Another and quite different report is now needed.

The businessman lacks the specially informed background of the Commission which the Patent Panel took for granted in writing its report. To give the industrialist an understanding of the consequences of the present law and the Commission's policies, a patent report must be written for a totally different audience, with little or no background in atomic energy, and with different questions in mind. The manner of its preparation might appropriately be left to the present Patent Advisory Panel. But, as in the case of the report on radioisotopes, in order to be useful it should anticipate the kind of questions to which businessmen want answers.

A simple but comprehensive report on the Commission's procedure in negotiating, awarding, and administering its numerous types of contract would also be useful. At present there is considerable fragmentary information on this subject but no well-organized comprehensive report that gives a clear picture of Commission policies and procedure. Education of industry in these matters should help to give effect to the Commission's objective of interesting additional companies in taking on Commission work.

Another question on which industrialists need information is the Commission's labor policy. Unless potential contractors are satisfied that the Commission's policy can be accommodated to the policy which the contractor follows in his labor relations generally, there are sure to be difficulties and a hesitancy to engage in work for the Commission. An informational report by the Commission or under Commission sponsorship could go far to eliminate the misapprehension that now exists in industry on this subject.

The subject matter for reports of value to industry could be extended indefinitely. As we have indicated, in some fields the Commission will profit by getting representatives of industry to prepare the reports under the general auspices of the Commission. In this way, the members of the group will themselves secure a valuable education about atomic energy, just as our Group has. Outside groups of this kind will, in addition, bring to the work a more direct knowledge of the questions that need to be answered for industry's benefit.

In some areas, on the other hand, members of the Commission's staff will be in the best position to prepare initial reports. This was certainly the case in the recent report on radioisotopes. In still others, the Commission may find it profitable to have a combination of staff members and representatives of industry work together.

However the work is done, it is of such great importance as to warrant the best efforts and talents the Commission can command. A vigorous well-organized program of reporting on the nonsecret phases of atomic energy for the specific purpose of educating industry would be received with enthusiasm. The reactions to this from industry would in turn suggest new lines of educational work. The net result would be an enlargement of industry's horizon on atomic energy with advantages both to itself and the Commission, and therefore to the public.

What we have said thus far is intended to illustrate ways in which the Commission can take the initiative in facilitating industrial participation by making information about its activities available in useful form. Our own study of the atomic-energy project indicates that as yet only a mere beginning has been made in the important reporting activities which are needed to increase industry's knowledge of the subject.

4 INCREASING DIRECT CONTACTS WITH INDUSTRY

In this report we have placed primary emphasis upon increasing industry's knowledge about atomic energy. As industry acquires a larger share of organized detailed information, we think that industry and the Commission, working together, will find many ways of increasing industry's part in the enterprise. But it will take much more than reports to provide industry with the knowledge it must have. There must also be broad personal contact with various phases of the enterprise.

An illustration drawn from our own experience is enlightening. One of our number is at present in charge of an important specific industrial research and development project. Among the knotty unanswered questions in his project is one relating

to the type of coolant to be used. During our survey, he observed, firsthand, a unique process that was being worked on in one of the Commission's laboratories to solve a problem which also related to coolants. The Commission's work immediately suggested to him a new avenue of approach to his own special research problem. He remarked at the time that even had he read about the Commission's investigation in the technical journals the chances are that he would have missed the connection with his own investigations. Direct personal contact with the work in the atomic-energy laboratory gave him the concrete experience necessary to see a relationship that he would otherwise have missed.

The experience just described is in itself a rather trivial incident. Yet it is out of a multitude of such trivial incidents, experienced by many people, that the massive forward movement of technology takes place. It is for this reason that we emphasize that the most comprehensive and competent reporting by the Commission will fail of its purpose unless it is complemented by extensive, individual, personal contacts between qualified technologists, industry leaders, and Commission personnel and work.

As we indicated, the branches of industry most likely to be interested in atomic energy are the chemical, petroleum, power, heat-transfer equipment, metallurgical, and instrument industries. Engineers and technologists in various companies in these fields are eager to learn about atomic energy. Many of their companies have no immediate thought of engaging in atomic-energy work, but they anticipate that they may become involved as future developments occur. In other areas of technology in which research and development are taking place, these engineers and technologists can without undue difficulty keep abreast of developments. They keep informed not only through the technical journals, but also through their contacts with industrial and university laboratories. In the case of atomic energy, these normal channels are closed to them.

We see no reason why engineers and technologists employed by industries with a legitimate future interest in atomic energy, or those nominated by responsible professional societies, should not be given sufficient clearance in the same way as Commission contractors and employees. It should be made possible for them to discuss developments freely with their professional associates who have been given similar clearance or who are engaged in atomic work under Commission contracts. If such engineers and technologists are required to stand the same kind of investigations and assume the same security obligations as the contractors' staffs, their access to secret information would no more prejudice security than that of the contractor's organization.

Contractors for some of the atomic-energy laboratories have had a policy, encouraged by both the Manhattan District and the Commission, of admitting on a consulting basis technologists from other concerns. But this policy has been practiced on a very limited scale. It is only a narrow example of the program we propose. It should be greatly broadened so that qualified and legitimately interested technologists can keep in touch with developments in atomic energy as they would keep informed of other scientific and engineering developments.

The suggested program will have many benefits. It will provide an opportunity for many technologists from industry to get the concrete, firsthand experience necessary to illuminate the Commission's published reports. Through these direct professional contacts, the outside technologists can also contribute constructive ideas on the problems of those directly engaged in the work—in ways that were frequently evident to our Group.

In developing the details of the program, the Commission should consult with the national engineering and scientific societies. In making its plans, the Commission should also consult directly as many of the interested industrial concerns as possible. But we think that the Commission and its contractors are already in a position to make an immediate beginning in such a program without awaiting its refinement in all details.

Even more important than these intimate contacts between outside technologists and the men presently engaged in the Commission's work is the development of a parallel program to bring outside executives in close touch with developments. In all of the industries likely to be interested in atomic energy—chemicals, petroleum, power, etc.—there are many men in top executive positions who have an over-all responsibility for technological matters in their companies. Usually these men themselves commenced their careers as engineers or scientists.

The Commission should develop a program to encourage and make it possible for these men to keep informed about atomic energy. There are several hundred such men in industry who should be given firsthand, continuing experience with the subject. But the experience must not be synthetic. The outside technologists—in contrast to the executive—will have a compelling professional interest in technical matters that can make his contact with Commission laboratories fruitful. The executive's interest in detailed technical questions, on the other hand will ordinarily be more remote. Attendance at special lectures sponsored by the Commission, visits to laboratories, and the like would have some value for him. What made our own experience so educational, however, was the fact that our survey was directed to a specific end, for which we felt a personal responsibility. Education was a by-product of our task.

One of the best devices to provide comparable experiences for other executives is the system of industrial advisory committees with which the next section is concerned. Another possible way to bring about purposeful industry contacts would be to encourage the setting up of a corporation owned and directed by a number of able companies in a given field or fields to assume responsibility for some major project.

5 INDUSTRIAL ADVISORY COMMITTEES

In our discussions with the Commission we were asked to give consideration to the desirability, scope, and make-up of a General Industrial Advisory Committee. We recommend that such a committee be set up in a relationship to the Commission functionally similar to that of the statutory General Advisory Committee. We shall discuss presently some of the purposes which such a committee might serve.

As to size, our Group favors a somewhat larger committee than the statutory General Advisory Committee, in order to represent the interested industries more broadly than a nine-man body could do. For the purpose we have in mind, a committee with as many as twenty members seems not impracticable. With such membership, balanced representation could be given to different industries and geographical areas. Members should be selected from among industrial leaders with enough technical background and scientific competence to permit them to judge the relative abilities of various technologists employed in their own industry and to comprehend the Commission's basic technical problems. We think that executives of companies having Commission contracts should not be excluded from appointment.

The usefulness of the permanent committee would be enhanced by an organized procedural setup for communications, reports, and regular formal meetings with the Commission or its representatives, two or three times annually. The committee, as in the case of the General Advisory Committee, should have

a permanent secretary in close contact with the Commission organization to take care of detailed contacts with the Commission.

The Industrial Advisory Committee should endeavor to keep informed of the general outlines of relations between the Commission and industry. It should also consult with the Commission at regular committee meetings, on broad questions of policy affecting such relationships with industry. In addition to these defined functions, other opportunities for using the committee and its members would certainly develop once it began functioning.

By virtue of their membership on the Committee, the men would be available more readily to provide a channel of communication between the Commission and industry. In the same way, committee members would be available to assist the Commission in the difficult problem of recruitment of key personnel having industrial experience. They would also frequently be able to assist the Commission in developing its preliminary approach to specific problems affecting industry. They would be of special assistance to the Commission in setting up temporary and special advisory committees to deal with specific problems.

The use of such temporary and special advisory committees for specific problems, in our opinion, has great merit. A year ago, when the Commission issued its regulations governing the export of certain types of equipment covered by the Atomic Energy Act, it announced that a special industrial advisory committee would be established to assist the Commission in its administration of the order. This is the type of committee which the war agencies, notably the War Production Board, used with effectiveness in administering similar orders during the war. We strongly recommend the use of such committees.

We suggest that the Commission's staff be alert to the opportunities for setting up and utilizing special committees in connection with other regulatory activities of the Commission, and in connection with other special problems when boundaries can be defined precisely enough to indicate a limited number of industries which would contribute specifically to the solution of problems. In creating these special committees, the Commission should look to the General Industrial Advisory Committee for assistance in establishing panels of possible members, defining terms of reference, etc.

It would be a mistake to overestimate the amount of direct assistance that general or special advisory committees can give the Commission in its problems. Industrial advisory committees can nevertheless be valuable to the Commission provided they are viewed in perspective as but one modest feature in solving the immensely large and difficult problem of industrial participation in atomic energy.

In our opinion, as we have already stated, a principal value of the advisory-committee idea lies in the education of industry. This would be a by-product of committee work. In order to perform their assigned task, no matter how special it might be, committee members would find it necessary to acquire a general background in the broad subject of atomic energy. The increased understanding they gained would flow, within secrecy limits, from the committee member through his own company and more generally in industry.

Perhaps most important, the advisory-committee program will lead to many ideas, now impossible to anticipate, for further expanding industrial participation in atomic energy. We should emphasize, however, that the committee system will not be effective for any purpose, unless the Commission and its staff can find ways to involve the committees directly in the Commission's problems.

6 FURTHER STRENGTHENING CONTRACT SYSTEM

At present and in all probability for a long time to come, the Commission's contract system will be the chief means of direct and substantial participation by industry in atomic-energy work. The Commission recognized this fact from the time it took over the enterprise and it has sought constantly to strengthen the system. In our study we have given particular attention to considering measures that would assist the Commission in this policy.

In our earlier conversations with the Commission we made a number of suggestions about this matter based on our observation of operations under a large number of the typical contracts. In the discussion of these suggestions which ensued, it developed that many of them were already in the process of being carried out on the Commission's own initiative. It is unnecessary for us to go into them at any length here. We do wish to emphasize, however, that the subject of contracts is one on which comprehensive public reports should be issued by the Commission to inform industry specifically and concretely of the measures which it is taking to make its contractual relations more attractive and more effective.

The contract system will, of course, be the subject of constant improvement and refinement as long as it continues. Areas in which improvements are especially necessary have to do with the development of special financial rewards that will be an inducement to excellence of performance, acceleration of personnel clearances which now seem to take an excessive period, and the formulation of contract provisions which will define more precisely the respective responsibilities of Commission and contractor.

A matter that deserves attention is the promotion of understanding among contractors generally of the Commission's over-all program and objectives and of how the work which is expected of them fits into the program. When this subject was discussed with them earlier this year, we were told that the Commission's program and its principal objectives had already been published in budget justifications, semiannual reports to Congress, and similar documents. These, however, are the type of scattered source materials, discussed in our section on Reporting, which should be brought together in an organized form and directed specifically to informing the Commission's contractors and potential contractors.

One of the most important factors in strengthening the contract system is the perfection of the general form of organization of the Commission so that it will be best suited to the administration of the contracts. Our comments in the next section bear more directly on this point.

There is, however, one special organization problem which directly concerns the contract arrangements themselves. We think that the contracts in the field of research and development, especially for reactors, should be set up in such a way that there is a clearer definition of the respective responsiblities of physicists on the one hand and engineer-contractors on the other. The physicist who is conversant with fundamental scientific theories is especially qualified by training and experience to determine whether it is possible to develop a reactor for a specific purpose and what the general characteristics of such a reactor should be. The research necessary for these determinations should therefore be under the general direction of qualified physicists. Engineers should be associated in the work at this stage in advisory roles.

For the second stage of the work, that of actual development, design and construction of the reactor, the engineer-contractor is better qualified by training and experience to take charge. The engineer-contractor will be better able to determine whether the particular reactor is practical from an engineering standpoint, whether it can be built within a reasonable time, and how to go

about the job of construction. During this stage the scientist should act in an advisory role.

As the Commission's contracts are now set up, this distinction between the quite separate roles of scientist and engineer-contractor tends to be blurred. This is perhaps a carry-over from the arrangements that were necessary during the pioneering wartime work. There, for a variety of special reasons, the direct authority of the physicist was extended into areas which an engineer is normally best qualified to conduct.

The more complex work which must now be done could be accomplished more effectively, in our opinion, if there were a clearer definition of responsibility. If the proper technique for dividing the job between scientists and engineer-contractors can be devised by the Commission, the work would become more attractive to industrial engineering organizations. As a result, industrial participation in this phase of the Commission's operations would in the true sense be fostered.

7 CHANGES IN COMMISSION ORGANIZATION

It is undoubtedly a Commission objective to organize its staff along lines which will co-ordinate its far-flung activities and provide adequate definition of responsibility and authority. Unless this policy is realized in practice, however, the numerous questions relating to industrial participation cannot be dealt with effectively. In studying the problem assigned to us we have been impressed with the fact that to expand industry's role in the work, the Commission must have a form of organization which will facilitate such participation. An effective cohesive Commission organization is just as important for the purpose of dealing with industry as it is for the purpose of performance of the other Commission work. In order to become involved in the atomic-energy enterprise, industry must have a soundly conceived Government structure with which to deal.

Reasons peculiar to the Commission's specific job of producing weapons and maintaining security could conceivably dictate an organization unsuited to industrial participation. If that were the case, then such form of organization would have to be accepted. But we believe that both for the purpose of carrying out the Commission's paramount functions and for that of facilitating industrial participation the same kind of organization is required.

In our discussions last June we pointed out two fundamental defects in the form of organization which the Commission then had. We observed, first, that too many of the Commission's top officials reported directly to the General Manager and that this created an intolerable burden of administration for one man. We suggested a regrouping of functions, a reassignment of executive responsibility within the Washington headquarters organization, and corollary changes in the functions of the field managers. These organization changes were proposed in part to relieve the General Manager of his excessive burden of direct supervision.

The changes announced in August in the Commission's organization will undoubtedly prove to be an improvement in this first respect, permitting the General Manager more effectively to delegate responsibilities to subordinate officers.

There was, however, a second and equally serious organizational defect to which our earlier recommendations were expressly addressed. Study of the Commission's activities in the light of our own experience with large industrial organizations led to the conclusion that the powers vested in the several field managers covered staff, scientific, and engineering authorities to an extent we considered unsound. Decentralization is a laudable objective. But under the decentralized method of operation which the Commission then had in effect, the activities within the jurisdiction of the field managers were determined by geographical location rather than by the type of activity or its relationship with other activities. The result was lack of essential co-ordination.

The field manager at Oak Ridge, for example, had full charge of all the important activities at that location whether or not they were related to one another. The same situation prevailed at Hanford, New York City and, we were informed, at Los Almos also. In varying degrees each of these field managers had charge of procurement or production activities as well as research and development. It was our view that this form of organization was conducive neither to highest efficiency nor to increasing industry's role in atomic energy.

The Commission's reorganization is a significant step in the direction we here think necessary. We refer to the centralizing in four executive divisions, i.e., production, military application, reactor development, and research—of responsibility not only for planning, programs, and budget, but also for supervision and execution of the programs.

The execution of the new plan is rendered more difficult because each of the several offices of operation has several of these basic programs in progress in its jurisdictional area. To accomplish the reorganization we are advised that the Commission is making the following changes:

1 Place under the Director and Division of Production:

  (*a*) The Division of Raw Materials and the mining, milling, and procurement of materials function;

  (*b*) The Office of New York operations whose primary assignment is to process and prepare feed materials for Oak Ridge and Hanford;

  (*c*) The Office of Oak Ridge operations;

  (*d*) The Office of Hanford operations; and

  (*e*) Such functions of the present Division of Engineering as relate to: (1) Export control of equipment and (2) the responsibility for engineering and construction of production facilities. We understand that this engineering group under the Director of Production will serve in a staff capacity for construction in all other areas within the Commission's interest.

2 Place under the Director and Division of Military Application the Office of Santa Fe (Los Alamos) Operations and all activities relating to the research, development, and production of weapons. In other words, in the Military field "research"—which might otherwise come under the Commission's Director of Research—and "production"—which might otherwise come under the Commission's Director of Production—will all be kept in one package.

3 Place under the Director of Research and the Division of Research the division of physical sciences and the division of Biology and Medicine. This, we are advised, will mean that the Division of Research will be responsible for the programs, budget, and technical supervision of all of the major national laboratories (except Argonne and Knolls); however, the actual contracts, under which the laboratories—Brookhaven, Berkeley, Ames, Oak Ridge, etc.—are operated, will continue to be administered in their business aspects by the most convenient office of operations.

4 Establish a new Division of Reactor Development with the full responsibility for the reactor program and, because of this, to have the office of Chicago operations and the Argonne National Laboratory report to the Director of this Division; and to provide that the Knolls Atomic Power Laboratory (which now operates under AEC's Schenectady office) also report to this Director.

These reorganization plans if vigorously carried out should have a most beneficial effect on the Commission's program. However, the plans do not altogether cure the conditions upon which we first commented in our June discussions. The original concentration of authority in regional managers remote from headquarters, which we questioned, has now been tempered by placing each of them directly within the jurisdiction of one of the headquarters' division directors and by assigning executive powers to the latter. This move should enhance the opportunities for better co-ordination of activities. But it represents only the first step in establishing the functional lines of authority which in our opinion would best promote the Commission's objectives. It is true that the new Director of Reactor Development is apparently to be given authority for all activities within the reactor field wherever they may be located. But elsewhere in the reorganization plans, this concept of functional direction seems to take second place to the accidents of geography. The Director of the Division of Production, for example, is given authority over the Oak Ridge, Hanford, and New York installations which are concerned not only with production, but also with important research and development activities. This same combination of headquarters' direction based in part on function, and headquarters' direction based on location of activities, appears to be present in other features of the reorganization plan. It is our hope that this condition can be regarded as merely an intermediate phase in the transition from the original organization to one in which each of the four headquarters' divisions will be given direct authority over those Commission activities—wherever situated—which match the functions of the respective divisions. When this organization goal is attained, the Commission should be in the best position both to co-ordinate its activities effectively and to provide clear channels through which maximum industrial participation in the work can be secured.

It is, of course, dangerous to entertain hard and fast rules about organization. There is, moreover, much room for variation in detail within any framework of organization and we recognize that some compromises must be made. We also agree with your General Manager that in final analysis it is the competence of personnel rather than form of organization which determines efficiency. But even competent personnel cannot get work done efficiently—including the work of bringing industry into atomic energy—unless organization lines are clear and appropriate to the job.

8 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1 The Atomic Energy Commission has made commendable progress in carrying out its responsibilities. The contract system, which it is continually seeking to strengthen, already gives industry an important part in the program. However, the only field of opportunity open to industry generally is in developments associated with radioisotopes. This is a very promising field. But atomic energy undoubtedly holds many other promising opportunities for technological development, although as yet they cannot be clearly visualized.

2 Greatly expanded industrial participation is needed both for the purpose of giving the Commission maximum assistance in solving its problems in the interest of national security and for the purpose of assuring a rate of technological advance in atomic energy comparable to that which the country has enjoyed in other fields. The necessity for Government monopoly in important areas and the present requirements of secrecy are serious obstacles to fully effective industrial participation. It is believed that these obstacles can be gradually reduced. The Government, however, must take the initiative with measures that will begin to set the normal processes of industry to work.

3 The essential precondition to increased industrial participation is knowledge of the subject so that industry may recognize opportunities to take part as they arise. Much information has already been published by the Commission, but most of it is not in a form that is useful to industry. In addition, a vast amount of nonsecret information, of potential value to industry, is buried in the files and activities of the Commission. In connection with certain other information, still classed as secret, the continuance of secrecy is of doubtful value. The Commission or groups acting under its auspices should organize and clarify already published material and issue reports on it in a form useful to industry. In the same way the Commission should publish in useful form the nonsecret but as yet unpublished information. Still secret information which is properly declassifiable and of special interest to industry should be declassified and published.

4 In order that published information about the Commission will be complemented by concrete firsthand personal contact with the subject, the Commission should develop a broad program for clearance (subject to appropriate security restrictions) of engineers, technologists, and executives in the interested industries. These include chemical, petroleum, power, heat-transfer equipment, metallurgical, and instrument industries. Engineers, technologists, and executives in these industries should be encouraged and given an opportunity to keep in touch with atomic energy in the same manner as they keep informed of other technological developments. In developing the details of the program, the Commission should consult national engineering and scientific societies, and the interested industrial concerns. The Commission and its contractors, however, should make a beginning in the program without awaiting refinement in detail.

5 A General Industrial Advisory Committee should be established by the Commission, and special and temporary industrial advisory committees should be created, wherever possible, to work on specific problems. These committees will be useful to the Commission in the solution of its problems, but even more important they will afford another means for bringing industry into direct personal contact with the subject matter of atomic energy.

6 The Commission should give particular attention to acquainting industry with the specific measures it is now taking to improve and strengthen its contract system of operation. A further report on the patent situation as it affects industrial participation is needed. In addition to these measures, the Commission should in the future set up its research and development contracts so that the proper roles of scientists and engineer-contractors will be more clearly distinguished. Further improvement of the Commission's own form of organization would also improve the contract system.

7 The Commission's recent reorganization of staff is undoubtedly a decided forward step but in the opinion of our Group does not go far enough to result in maximum efficiency either from the standpoint of the Commission's internal operations or from the standpoint of increasing industrial participation in atomic-energy development. Geography, which often has little to do with the boundaries of the Commission's problems, is nevertheless one of the keystones of its organization. As opportunity presents itself, changes should be made to set up the operations of the Commission more firmly on a functional basis, in accordance with industrial experience, so that there will be more clear and definite lines of responsibility.

CAVITATION-FREE INLETS *and* CONTRACTIONS

Electrical Analogy Facilitates Design Problem

By HUNTER ROUSE and M. M. HASSAN

IOWA INSTITUTE OF HYDRAULIC RESEARCH, STATE UNIVERSITY OF IOWA, IOWA CITY, IOWA

CAVITATION has long been recognized by designers of turbines, pumps, and marine propellers as a cause of serious structural damage and loss of power. Within the past decade, moreover, its occurrence has been observed in many other engineering fields, notably in flow through hydraulic structures. Since deterioration of concrete and steel in zones of cavitation may eventually endanger the structure as a whole, complete avoidance of the phenomenon by proper design of flow passages is obviously a desirable goal.

In accordance with the Bernoulli theorem, cavitation will occur when the pressure intensity of flowing water is reduced to the vapor limit at points of high local velocity. Proper design of a transition section therefore requires that the boundary profile be curved in such manner that excessively high velocities—and hence excessively low pressures—are eliminated. The ideal form of a given type of transition is evidently one in which the pressure does not fall at any point below its final magnitude—a well-faired contraction, for example, in which the boundary pressure varies continuously from its maximum value in the uniform zone just before the entrance to its minimum value in the uniform zone just beyond the outlet.

There is, unfortunately, no simple analytical means of designing such a transition for required performance, or even of predicting the performance of a given design. The customary practice of considering only the mean velocity and pressure for the entire cross section is not sufficient for the purpose, since in curvilinear zones the boundary pressures will differ markedly from the cross-sectional means. On the other hand, it so happens that the streamlined conditions most conducive to cavitation-free operation are also those most readily susceptible to exact hydrodynamic analysis based on the theory of potential flow, and various mathematical techniques are at hand for either the design of the boundary profile or the prediction of the pressure distribution. Such methods are, however, extremely tedious, and any simplification of the mathematical procedure by other means—such as the electrical analogy—usually represents a great economy of time and effort.

The electrical analogy has been used quite frequently in the past for the convenient solution of problems in two-dimensional fluid motion. In principle it is based upon the fact that the flow of an electrical current through a homogeneous conductor follows the same pattern as the irrotational (i.e., nonviscous) flow of a fluid through a passage having a similar boundary form, as indicated schematically in Fig. 2. In other words, the rate of change in electrical potential dE/ds along any path line of the electrical current is proportional to the rate of change in velocity potential $d\phi/ds$ along the homologous stream line. Since the velocity v is proportional to the rate of change in velocity potential, the following approximate equalities may be written for small but finite increments of distance along the lines of flow

$$v \approx \frac{\Delta\phi}{\Delta s} \approx C\frac{\Delta E}{\Delta s}$$

whence

$$\frac{v}{v_0} \approx \frac{\Delta E}{\Delta E_0} \qquad [1]$$

If the loss in head is neglected (as it may safely be in a well-designed inlet or contraction), the Bernoulli equation may be reduced to the following dimensionless form

$$\frac{h - h_0}{v_0^2/2g} = 1 - \left(\frac{v}{v_0}\right)^2 \qquad [2]$$

Herein h is the piezometric head, or the sum of the pressure head p/γ and the elevation z, for the point in question. As may readily be seen from Equations [1] and [2], determination of the distribution of electrical potential throughout the conductor will permit evaluation of the distribution of piezometric head (and hence pressure) throughout a geometrically similar flow passage. For present purposes the experimental procedure thus reduces itself to either successive changes in the form of the conductor until the desired distribution of pressure is indicated, or simply the measurement of the distribution for a prescribed boundary form.

The foregoing relationships apply, needless to say, to three dimensional as well as two-dimensional flow. Even under

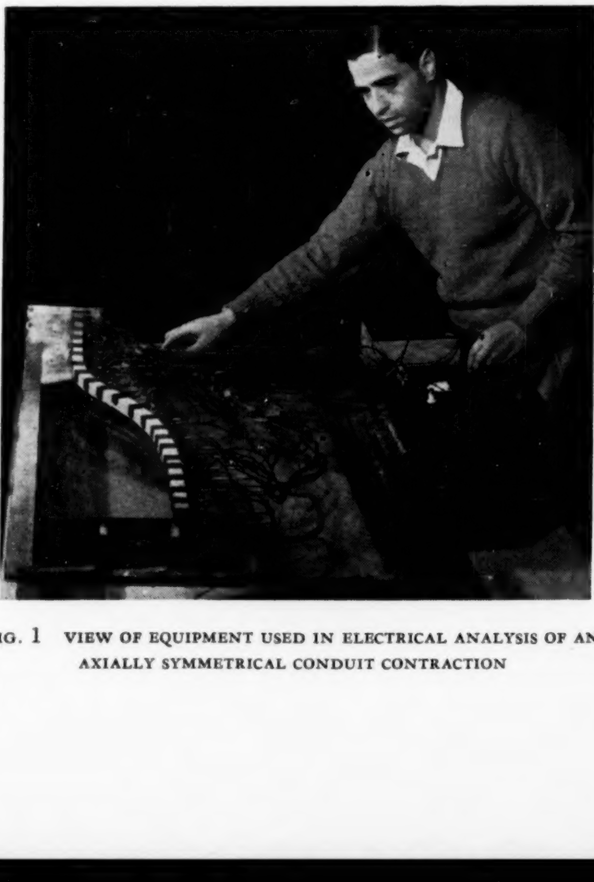

FIG. 1 VIEW OF EQUIPMENT USED IN ELECTRICAL ANALYSIS OF AN AXIALLY SYMMETRICAL CONDUIT CONTRACTION

conditions of axial symmetry, however, the actual technique of such an investigation would be rather difficult were it not for the fact that it is necessary to simulate only a segmental portion of the actual flow passage—one having such a small central angle, in fact, that the outer boundary need be curved in only one plane. That is to say, the conductor may be an electrolytic bath confined between an inclined sheet of plate glass, two terminal plates, and a flexible strip of plastic to represent the boundary profile, as shown in Fig. 3 for the axially symmetrical counterpart of Fig. 2; the center line, of course, corresponds to the line at which the depth of the electrolyte becomes zero.

In most previous instances, the procedure has involved the use of an electrode on a movable probe to trace lines (or surfaces) of constant voltage, by means of which a fair approximation of the entire flow pattern may be obtained. However, not only is present interest limited to the pressure distribution along the boundary, but the required accuracy of measurement makes it necessary to replace the customary probe with a series of fixed electrodes accurately located along the inner face of the flexible strip. With prior knowledge of the electrode spacing, determination of the voltage between each successive pair at once yields through Equation [1] the relative velocity—and hence, through Equation [2], the relative pressure—at essentially the mid-point between each pair.

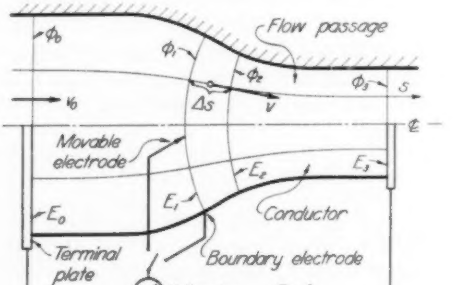

FIG. 2 SCHEMATIC REPRESENTATION OF ANALOGY BETWEEN IRROTATIONAL FLUID FLOW AND FLOW OF AN ELECTRICAL CURRENT FOR A TWO-DIMENSIONAL BOUNDARY CONTRACTION

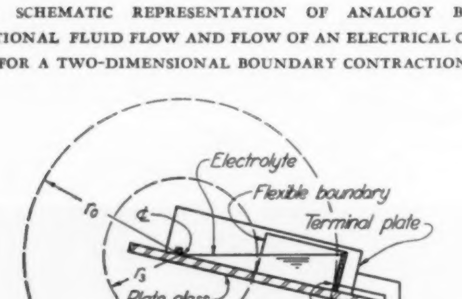

FIG. 3 CROSS SECTION OF ELECTROLYTIC BATH SIMULATING LONGITUDINAL SEGMENT OF THREE-DIMENSIONAL COUNTERPART OF FIG. 2

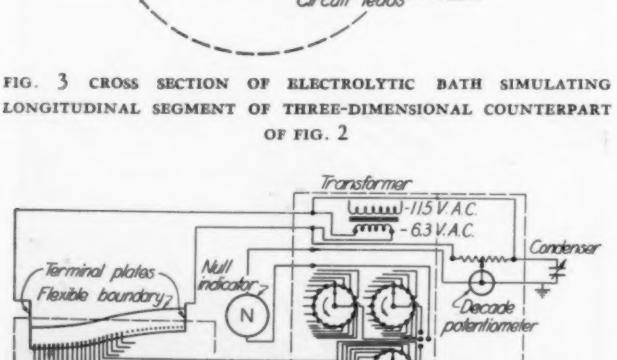

FIG. 4 CIRCUIT DIAGRAM USED BY THE IOWA INSTITUTE OF HYDRAULIC RESEARCH

During two years of investigation at the Iowa Institute of Hydraulic Research under Contract NObs-24084 with the Navy Bureau of Ships, the circuit shown in Fig. 4 has proved particularly useful in such measurement. As described in an Institute report to the Bureau of Ships, "Exploratory Tests on Application of the Three-Dimensional Electrical Analogy," by Philip G. Hubbard, application of Ohm's law makes it possible to replace the potential gradient dE/ds at any point by the local resistance gradient dR/ds, the resistance being determined by the Wheatstone-bridge method with the point in question as that which draws no current when the bridge is balanced. In this case Equation [1] takes the form

$$\frac{v}{v_0} \approx \frac{\Delta R}{\Delta R_0} \qquad [3]$$

The electrical measurements are thus made by means of a simple bridge circuit wherein a precision decade potentiometer is connected in parallel with the terminal plates through which a constant voltage is applied to the electrolyte. A sensitive null indicator is connected between the potentiometer and each electrode along the boundary, and a variable-range condenser is used in parallel with the potentiometer to minimize the effect of capacitance and thereby increase the sensitivity of the apparatus.

In view of the fact that errors in the velocity determination are magnified when velocity ratios are squared to yield the relative change in piezometric head, various precautions have proved necessary to insure satisfactory results. In zones of marked boundary curvature, the electrodes should be flush with the boundary surface, and of as small diameter and spacing (0.015-in. wires perhaps $^1/_2$ in. on center) as precision of linear measurement justifies. (To be noted in this connection is the fortunate fact that local errors will be compensative rather than cumulative, since differences in readings are used for successive pairs having a common intermediate electrode.) In order to minimize polarization effects at terminal plates and electrodes, all should be of copper in conjunction with an electrolyte of copper sulphate (about 0.01 mol) dissolved in distilled water. Despite the addition of sulphuric acid (perhaps 0.02 mol) to prevent corrosion, each electrode must be cleaned with a fine glass rod before its reading is taken, and the entire electrolyte must be stirred frequently to maintain a uniform temperature. All boundary joints should be sealed with paraffin to prevent short circuits. A precisely finished paraffin wall at the center line will permit the electrolyte to approach a zero depth without capillary irregularities. The boundary curve may best be shaped according to an accurately formed template placed along the glass bed.

Before proceeding with the experimental program described in the following paragraphs, the technique just outlined was checked against three known conditions of flow to determine the degree of accuracy which could be expected. First, flow was simulated through a cone of uniform taper, for which the pressure may be shown to vary directly with the fourth power of the radial distance from the apex; the results obtained electrically were practically indistinguishable from those which were calculated, despite the fact that the terminal plates were, for simplicity, left plane rather than curved in circular arcs. Second, a contraction designed analytically by hydrodynamic means was reproduced; the experimental and analytical results

were again in satisfactory agreement—except at the limits, due to the fact that the analytic curve was infinite in extent whereas the simulated curve became linear within 1 per cent of the theoretical diameter ratio. Third, a fire nozzle with a profile consisting approximately of cubical arcs was investigated electrically and tested as well under actual flow conditions. The results differed no more than variations subsequently discovered in the nozzle construction would lead one to expect (a maximum discrepancy in $[h - h_0]/[v_0^2/2g]$ of 3 per cent for a variation in diameter of $2^1/_2$ per cent).

The subsequent program consisted of two successive parts: First, a systematic investigation of contractions formed of cubical arcs, on which the dissertation "Use of the Three-Dimensional Electrical Analogy in the Design of Conduit Contractions" was submitted to the Graduate College of the State University of Iowa by the junior author in partial fulfillment of the requirements for the degree of Doctor of Philosophy; second, a similar investigation of inlets formed of elliptical curves. These projects were sponsored jointly by the Iowa Institute of Hydraulic Research, the Bureau of Ships under Contract NObs-24084, and the Office of Naval Research under Contracts N7onr-495 and N8onr-500.

For the tests on axially symmetrical conduit inlets, reference is made to Fig. 5, which shows the co-ordinate notation and results of a typical run. (The terminal plates, it should be noted, were necessarily located so far—about $3r$—from the curvilinear zone as to be invisible in the figure.) As a general rule, too rapid curvature of such an inlet will give rise to a pronounced drop in pressure (i.e., piezometric head) just before the juncture between the curved and the uniform sections, the pressure thereafter rising to that of the uniform flow. This low-pressure zone must be eliminated by easement of curvature before the inlet can be regarded as truly cavitation-free. The tests hence involved the following series of runs: For successive

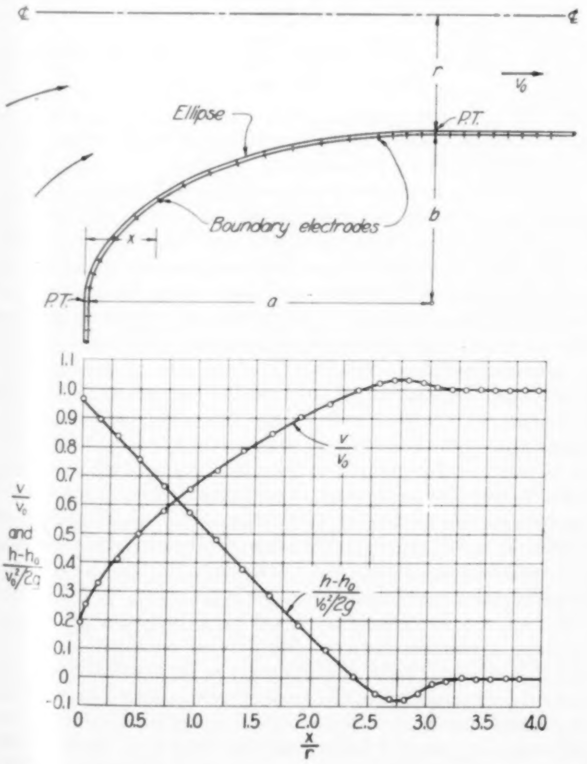

FIG. 5 CO-ORDINATE NOTATION AND TYPICAL RESULTS FOR ELLIPTICAL INLET PROFILE

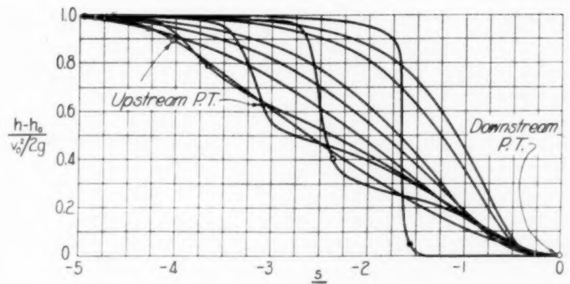

FIG. 6 LIMITING CURVES OF RELATIVE PIEZOMETRIC HEAD FOR CAVITATION-FREE INLETS OF ELLIPTICAL PROFILE

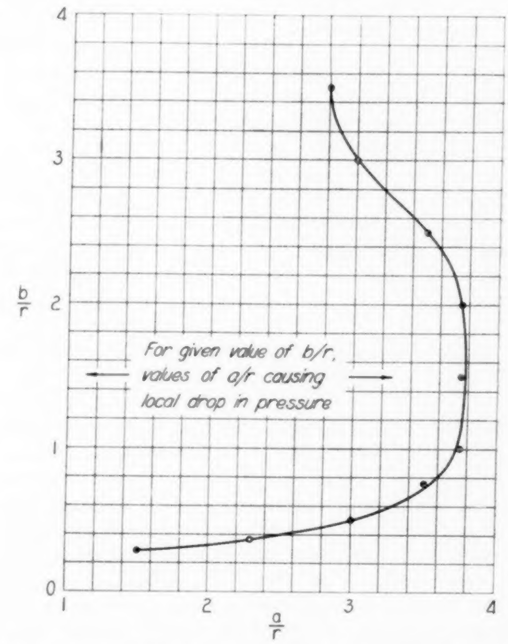

FIG. 7 PLOT OF INLET CO-ORDINATES FOR LIMIT OF CAVITATION-FREE DESIGN

ratios of b to r, families of elliptical boundary curves representing different ratios of a to r were investigated electrically. The form which just eliminated the pressure drop in each series was determined from a plot of the maximum drop in relative piezometric head against the longitudinal co-ordinate ratio, and this form was then subjected to a check test. The resulting distribution curves for such borderline conditions are superposed in Fig. 6, as functions of developed distance upstream from the points of tangency, and the corresponding co-ordinate values are plotted in Fig. 7. The latter diagram evidently permits the design of axially symmetrical cavitation-free inlets, through use of an elliptical profile for which a/r is greater than that of the plotted curve for the given or chosen magnitude of b/r. Of interest in this connection is the fact that the lower limit of the curve corresponds closely to the contraction ratio of a free jet from a circular orifice. Just as the free-jet profile (often taken as the basis for inlet design) is actually not an ellipse but an infinite curve, it should also be understood that none of the elliptical sections is presented as the best possible solution, but only as a close—and convenient—approximation thereto. On the other hand, proper performance of any limiting section requires its accurate reproduction in the final structure; therefore selection of a greater magnitude of b/r than that of the free jet, together with an

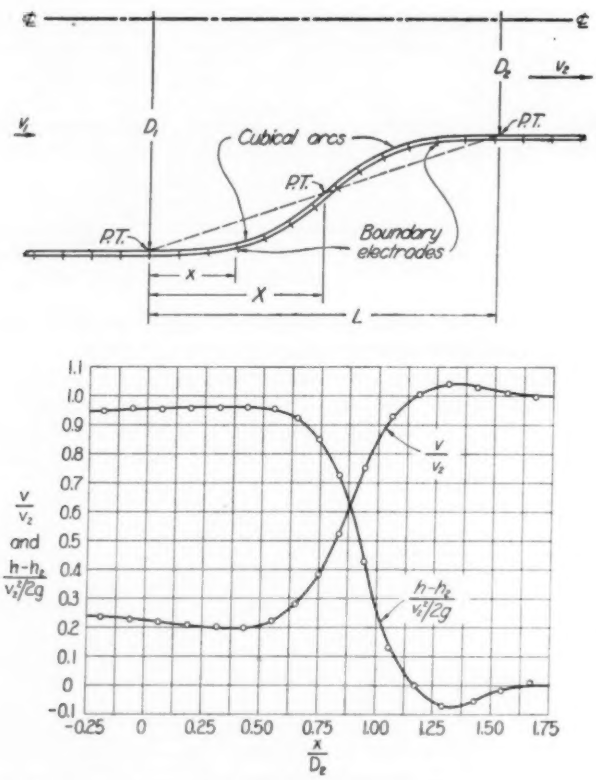

FIG. 8 CO-ORDINATE NOTATION AND TYPICAL RESULTS FOR CUBICAL-ARC CONTRACTION PROFILE

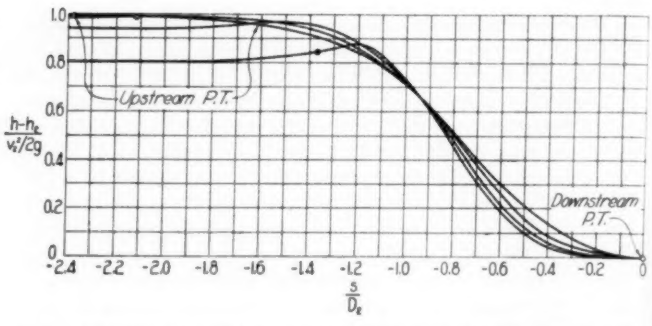

FIG. 9 LIMITING CURVES OF RELATIVE PIEZOMETRIC HEAD FOR CAVITATION-FREE CONTRACTIONS OF CUBICAL-ARC PROFILE

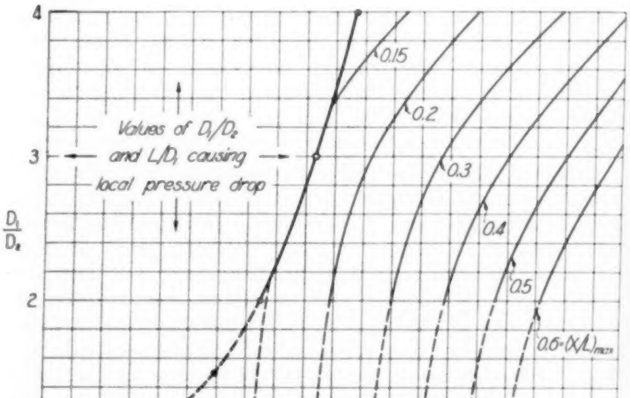

FIG. 10 PLOT OF CONTRACTION CO-ORDINATES FOR CONDITIONS OF CAVITATION-FREE DESIGN

increase of a/r beyond the limiting value indicated by the curve, would not only be in the interest of safety but would also permit reasonable flexibility in construction without danger of cavitation.

For the tests on conduit contractions, reference is made to the similar definition sketch of Fig. 8, for which essentially the same general comments are applicable. In this case, however, cubical arcs (i.e., curves of the form $y = ax^3$) are preferable to either elliptical or circular arcs, owing to the fact that their radius of curvature is infinite at their points of tangency with the uniform sections, thus alleviating to an even greater degree the tendency for the pressure to drop just before the end of the transition. The procedure in this series differed from that for the inlets, in that the pressure distributions were determined for a systematic progression of diameter ratio D_1/D_2 (from 2 to 4), of length ratio L/D_1 (from 1 to 2), and of inflection ratio X/L (from $^1/_6$ to $^2/_3$), in the effort to secure a representative sequence of interpolation plots. Since this series was completed before that of the inlets, plots similar to Figs. 6 and 7 were subsequently obtained from the general family by means of interpolation (and extrapolation, for diameter ratios less than 2), as presented in Figs. 9 and 10. Except for its indirect evaluation, Fig. 9 is fully comparable to Fig. 6. Like Fig. 7, Fig. 10 includes a heavy line for the critical limit between cavitation-free profiles and those resulting in a local pressure drop. Unlike Fig. 7, however, the entire area to the right of the limiting curve in Fig. 10 represents the co-ordinate region of cavitation-free conditions, provided only that X/L be equal to or smaller than the values indicated. This diagram should likewise permit the selection of transition characteristics for a given diameter ratio and a permissible length ratio; the greater the latter value, of course, the less susceptible to cavitation any contraction becomes, and the less exact the construction of the profile needs to be.

Use of the electrical analogy as presented herein is by no means restricted to conduit transitions—nor to the elimination of cavitation. In fact, the design of inlets or contractions in this manner prevents as well the occurrence of separation through reduction or elimination of adverse pressure gradients, and a similar procedure is adaptable to the study of flow around submerged bodies of revolution. The rapidity with which the pressure characteristics of any given boundary profile may be studied (about one day was required to form, measure, and evaluate each of the foregoing profiles) recommends its application to a wide variety of boundary configurations which would otherwise require either a great deal of time for analytical investigation or a great deal of equipment for actual reproduction. The technique is, it should be noted, also readily adaptable to the study of many free-surface phenomena, since the free surface is simply a boundary along which the pressure is constant.

For those still inclined to regard with doubt the probability of close agreement between the flow of an electrical current and that of a true fluid, the fact must be emphasized that, even as a first approximation, the analogy will permit a vast amount of exploratory work to be accomplished with a minimum expenditure of time and funds, and that final tests of designs obtained in this manner may then be conducted under actual flow conditions.

TECHNICAL LITERATURE

Its Responsibility as an International Influence

By JAMES S. THOMPSON[1]

FROM Moscow to Melbourne, from Johannesburg to London, comes continuous evidence that technical literature, having no ideological connotation, is proving a dynamic vehicle in knitting together all peoples of this war-weary world. Race, religion, politics, and other social factors present no barrier in this interchange of educational information.

Technical literature as a subject contains countless ramifications, problems, and potentials, all of which are interpreted in varying relative values depending upon national viewpoint.

What contrasts are presented in a comparison of science, technological methods, and communications, as known in the ancient civilizations of the eastern Mediterranean, and those of today!

What a vast gap is to be seen between the application of arithmetic and elementary geometry in ancient Egypt, and the function today of Vannevar Bush's highly complex machine, the differential analyzer!

What a vast difference there is between the printing on papyrus, the carving on stone, and today's flood of educational material produced through intricate techniques in printing, illustrating, and radio transmission!

Herodotus, as he recorded, was impressed by the 20 years required for the building of the Great Pyramid, by the fact that 100,000 men worked in three-month shifts to achieve its completion. How would his mind grasp the implications of such immense corporations as du Pont, General Electric, and General Motors—the productivity and living standards of the thousands employed in their diversified programs?

How casually we read in the newspapers of the perfection of an inkless printing process; of the development by RCA, NBC, and Eastman (1)[2] of a microwave process called "Ultrafax" which can transmit the entire half-million words of the novel "Gone With the Wind" in under two and one-half minutes. "The 'Winged Words' so often mentioned by the blind Homer more than 2000 years ago have now become literal images," editorialized *The New York Times*.

Postwar interest in engineering education, science, industrialization, and in the interchange of information generally, has been continuously sustained on an international level. This has thrown the spotlight emphatically upon the authors, publishers, librarians, distributors, and translators—in fact, upon all those responsible for the technical literature emanating from government reports, from professional-society proceedings, and from commercial publishing houses.

This paper represents a United States viewpoint achieved through personal association with all three sources of such literature. Currently, it has been stimulated by extensive travel in Europe and Latin America, and enriched by contacts with business associates now or but recently returned from virtually all other parts of the world.

The author has here attempted to reflect the combination of idealism and hardheaded realism personified in the engineering educators with whom he has been associated intimately for a full generation. He also wishes to deal with and focus on some of the practical problems faced by publishers who wish to co-operate fully with plans now under dicussion by UNESCO and other international bodies.

He feels it is a real privilege to be permitted to supplement his paper presented to this organization in Paris in 1946, entitled "International Cooperation in Technical Translation," and wishes to re-emphasize here the reciprocal value inherent in the acceleration of an international exchange of literature.

In this presentation of technical literature, the author will attempt to define the subject under six general headings as follows: (*a*) Historical background; (*b*) geographical evidence today; (*c*) current trends and influences; (*d*) responsibilities; (*e*) problems; and (*f*) challenge.

HISTORICAL BACKGROUND

"The invention of printing in the 15th century contributed more than any other single factor to the promotion of international scientific relations," states Frans Verdoorn in the journal *Science* (2). It then became possible to circulate scientific material in book form and even, though rarely, on a broadside. Scientific journals, however, did not exist until the middle of the 17th century, when they stemmed naturally out of the spread of scientific academies throughout Europe. In Italy the first of such academies were established about 1560, followed by the founding in Vienna of the Academia Naturae Curiosorum in 1651, the Académie des Sciences in 1666, and in Germany of the Collegium Curiosum in 1672. The Académie des Sciences, whose history is virtually a record of the rise and progress of science in France, traces back to the early part of the 17th century, and had among its members, Carnot, the engineer. The Royal Society of London, established in 1660, first put its findings and proceedings into print in 1665 in the form of *Philosophical Transactions*. From this time on the scientific academies, such as the Linnean Society of London (founded in 1788), and the American Philosophical Society (founded in 1744), published their Transactions on a regular basis. The establishment of migratory societies meeting annually in Germany had their inception in these scientific organizations, and the founding of such august bodies as the British Association for the Advancement of Science in 1831, and the American Association for the Advancement of Science in 1848, were succeeded logically by regularized meetings of scientific congresses and societies on an international level.

In modern times the increasingly global focus of interest in industrialization, technical education, and related matters is reflected on a historical level by the rising curve in the output of technical books. In Great Britain during World War I and World War II, for example, the importance of scientific and technical publishing in the national economy was emphasized dramatically when official priority toward this type of publication virtually excluded from importation all other printed matter.

In 1947 the author visited eleven European countries and was able to report in *Science* (3) that of the eight supplying statistics,

[1] Vice-Chairman of the Board, McGraw-Hill Book Company, Inc., New York, N. Y. Associate ASME. Delegate, The American Society for Engineering Education and the Engineers Joint Council Committee on International Relations to the World Engineering Conference and the Second International Technical Congress in Cairo, Egypt, March 20–26, 1949.

[2] Numbers in parentheses refer to the Bibliography at the end of the paper.

all without exception reported an increase in 1945 in output of technical literature over 1938. This occurred in spite of paper and man-power shortage, and in spite of the general dislocation caused by the war. In Italy, which provided an extreme example, the total output of new technical books in 1946 had increased 10 per cent over 1938, while the over-all total of new books had dropped 55 per cent. In Switzerland the total number of technical volumes published had increased nearly threefold. In Germany, however, the cultural decline under the Nazis is only too well known. In his book "Alsos" (4), Goudsmit, American scientist of Dutch background, tells of a visit to Germany shortly after VE Day. On a secret mission under U. S. Army auspices, he renewed his contacts with prewar colleagues for the purpose of discovering the extent of German research in nuclear physics. He was able to report at firsthand the tragic deterioration of technical authorship and publishing in a country where only a few years ago the names of Springer, Ullstein, Fischer, and others were bringing it world renown.

GEOGRAPHICAL EVIDENCE TODAY

Technical publishing in the United States, both as regards number of books released and firms operating, has grown impressively over prewar years. The increase, in circulation of technical books can be interpreted as reflecting the over-all situation on a world-wide basis regarding movement and location of students, members of professional societies, and those of commercial organizations. The following points provide ample demonstration to this effect:

1 Following World War II, export of United States technical literature has far surpassed records of prewar years. One publisher reports that his export sales for 1947 were eight times those before the war—approximately 50 per cent to Europe, 16 per cent to Canada, and 10 per cent each to Asia and Latin America. His domestic output, on the other hand, had merely doubled. Naturally, this increase in circulation and its direction is in part due to the fact that the normal source of supply in Europe cannot begin to fill the demand during this postwar period. These figures show too the far-flung interest in North American progress in engineering, technology, and productivity.

2 Of the five principal engineering societies in the United States nearly 10 per cent of the 90,000 members reside abroad, in 100 different countries.[3] Through receipt of periodicals published by their respective societies, these engineers are able to keep fully informed of all the developments in their fields that are of current interest to student and practitioner alike.

3 An example of international circulation of United States engineering periodical literature is indicated in the following 1947 totals for the 33 magazines of the author's company: Practically all of the 100 countries of the globe are represented in the grand total of 150,000 subscribers, and the eight general areas were represented percentagewise as follows: Africa, 3 per cent; Asia, 3 per cent; Australasia, 5 per cent; Canada, 20 per cent; Europe, 22 per cent; Latin America, 40 per cent; U. S. possessions, 3 per cent; and the West Indies, 3 per cent.

4 Engineering students in the United States from abroad during the 1947–1948 period were estimated at approximately 5000, coming from some 100 countries.[4] The fact that the United States recognizes the importance of encouraging students from abroad was highlighted during the summer of 1948, in an experiment whereby 70 selected graduate engineers from 17 European countries were enrolled at the Massachusetts Institute of Technology (5). It is axiomatic that these and other foreign engineering students returning home retain their English-language textbooks for permanent reference. Similarly Americans abroad on Fullbright funds, Rockefeller or Guggenheim scholarships, or otherwise, will return with their private libraries enriched by new foreign acquisitions.

5 The statistics of translation rights, consummated since 1940, give further evidence of the spurt of global interest in United States technical literature. In a survey which the author made in 1948 it was reported that twelve leading United States technical publishers reported rights contracted during the preceding seven years as follows: Spanish, 175; Portuguese, 45; French, 40; Japanese, 16; Italian, 13; Chinese, 13; German, 12; Swedish, 10; Polish, Dutch, and Czechoslovakian, 4 each; Norwegian and Danish, 2; and Arabic, Finnish, Hebrew, Hungarian, and Persian, 1 each (6). It should be pointed out here that it evidently will be the efforts of individual publishers which, in the last analysis, will produce ultimate success for international translation programs.

6 At present, owing to military controls, virtual paralysis continues to prevent the importation of books into Austria, Germany, and Japan. A similar situation in China is exaggerated by the currency collapse. On the other hand, it is possible to observe a definite increase in circulation in India, Burma, Indonesia, and some parts of the Near East, areas which before World War II were relatively inconsequential in terms of demand.

The U. S. Army's orientation program offers spectacular evidence of the place of translated technical literature in rehabilitating a war-ruined country. In Japan, according to a statement to the author by Colonel Greene of the *U. S. Infantry Journal*, which is acting as liaison between U. S. and Japanese publishers, technical and scientific books predominate.

Contact with Soviet publishers continues to remain impersonal and remote with decreasing interest on the part of U. S. publishers as dispatches reveal the attempts to make scientific authors write in accordance with political teachings. The steady flow of U. S. books in English moving in increasingly large numbers on the day of publication to Russian educational, governmental, and other scientific centers and academies constitute impressive evidence of the sincere interest in U. S. "know-how."

The traffic is of course almost exclusively one way. In recent months, the author has had three invigorating but fruitless attempts to carry on continuously and successfully with Soviet personnel. The first was in the case of his friend and associate, Robert Magidoff, who in March, 1948, was expelled from Moscow on a trumped-up charge of spying. During his 13 years there he had made many but vain attempts to secure agreements to publish co-operatively. We all agreed that although even in the old Czarist regime there had been no copyright treaty with the U. S., and the philosophies of ownership of private property were now utterly alien in the two countries, yet it seemed that since my firm was ready, willing, and did in two cases, much to the astonishment of the Russians, pay royalties as a matter of course, the converse for the satisfaction of all individual authors concerned could be a logical agreement.

The second contact was with the official literary agent, the famous Earl Browder, who produced a handful of scientific monographs but in no case did the critics believe translation feasible. In general the critics rated them as on a par with U. S. college undergraduate theses. After more than a year the author is still waiting for Mr. Browder's promised delivery of royalties on the unauthorized translations of Nadai's "Plastic-

[3] Of these, 2600 are electrical engineers, 2300 mining and metallurgical, 1000 mechanical, 800 civil, 200 chemical engineers. The largest unit is in Canada.

[4] These included 471 from India, 439 from China, 393 from Canada, 183 from Turkey.

ity" and Den Hartog's "Mechanical Vibrations." These were to be test cases, taken at random from a vast number of Soviet sponsored translations without authority or payment of fees.

The third event occurred last spring on the day that the Czechoslovak premier came to a mysterious end. Tom Falco of my firm's Washington office had secured an appointment for me with Soviet Ambassador Panyushkin. He said it was the first one allowed a U. S. publisher. We assumed it happened because I had said I wanted to discuss student and professorial exchange possibilities in connection with the paper I was preparing for the meeting of the American Society for Engineering Education (6). We had 40 minutes of most cordial talk ranging all over the field of exchanges, missing royalties, "iron curtains," which he said did not exist, and I got the promise of aid in securing for the U. S. Library of Congress a much-prized comprehensive bibliography. But that was all and the latter is still only a promise. This did not seem to be the right moment to project exchanges.

A manuscript on cancer research was the main object of each contact. Magidoff urged coming to Moscow for personal conferences. Browder encouraged the idea but reminded me that two months were needed to overcome red tape. Panyushkin implied that although cancer research is not engineering he agreed that a reciprocal possibility existed since the Russians would be securing soon copies of our new National Nuclear Energy series.

The "Voice of America" could well broadcast now for all Soviet scientists and publishers that if, in Russia, as reported, real progress in controlling this great scourge is materializing, then internationally the respective publishers in both the U. S. and the U.S.S.R. should lose no time in collaborating.

Having the greatest respect, after personal association, for such eminent engineers and scientists of Russian birth as Bakhmeteff, Sokolnikoff, and Timoshenko, to mention only three, I look forward eagerly to the earliest opportunity to explore such a venture, the consummation of which might well be an important step in removing the spirit of suspicion and distrust between our countries which has emerged in recent months.

From the reciprocal viewpoint, Argentine-U. S. relations will be highlighted shortly by the publication in New York of the English translation of the famous book on Physiology by Dr. Houssay, the Nobel prize winner, who was expelled by President Peron from the University of Buenos Aires. Lecturing in North American Universities, he exemplifies the superiority of science over politics.

Like the Bailey bridges which in World War II projected themselves successfully ahead regardless of enemy fire, I believe that books can establish communications between people of all languages and customs. Since a year ago I have visted 21 different countries and must confess that though the regulations and the evidences of government differ widely, the people seem just about the same everywhere and the fundamentals in engineering and science are of course the same throughout the world. "Maximum circulation of authors' ideas regardless of language barriers" will continue to be my slogan, as it has for months, in technical papers and talks.

CURRENT TRENDS AND INFLUENCES

Technical publishers in North America are forced to admit that the dynamic character of the export trend is due not to the influence of their sales departments, but rather to spectacular developments necessitating new published material, and new and varied factors abroad influencing reading habits and requirements. These factors can be separated into eleven categories:

1 Most important is a universal trend toward industrialization, the development of new applications in science, and an accompanying awareness of the necessity for technical knowledge supplied by adequately trained personnel. This is particularly evident in India and the eastern Mediterranean.

2 The European Recovery Program exercises a real though indirect influence whose effects will be apparent in the months to come. The place of technical literature within the scope of the Marshall Plan can be seen from the statement of Paul Hoffman, United States Economic Cooperation Administrator, who gave the author permission to quote him: "The intelligent use of technical information has always been a basic element in getting increased productivity out of an industrial plant. Therefore, we at ECA feel that such information can play a significant part in the European Recovery Program. The importance of all this is recognized in the Foreign Assistance Act itself—the ECA legislation—which provides for the 'Procurement of and furnishing technical information and assistance' by the Administrator." Of great significance was the announcement on December 4, 1948, just as this paper was released, that the United Nations General Assembly had voted at Paris, four proposals of a similar nature, aimed at promoting the economic programs of underdeveloped countries, including thorough technical training and exchange of information on technical problems. The vote was 47 to 0 with 6 abstentions.

3 A marked influence on the demand for technical books for use abroad was created during World War II by United States Army and Navy personnel and civilian technicians scattered throughout the world. Today that demand, though naturally smaller in volume, nevertheless still reflects the influence generated by the widening circle of American-trained engineers—not only those in permanent residence but also those acting in a temporary capacity as inspectors, critics, or reporters on projects developing from bank loans and foreign-government controls.

A local example of international technical co-operation is that of the United States Navy's Research Unit which has joined with the experts of the Egyptian government in making studies of water purification in this part of the world. The work of the University of California Research Unit on tropical diseases in Africa is another. The Iranian government, for another example, has contracted with a group of eleven United States engineering companies (7) to act in an advisory capacity in a study of existing economic and social conditions upon which its new \$650,000,000 development program of the country's mineral, agricultural, and industrial potential may be based. "Adequacy of technically trained personnel is a fundamental," the author was told by an official of the consulting group.

4 As mentioned previously, memberships abroad in American professional-engineering societies, which increased 15 per cent over prewar totals, constitute with their respective journals and periodicals another significant influence having a cumulative effect. These societies should continue to spread their influence. The character of this trend has been stated well by Robert M. Gates, past-president of The American Society of Mechanical Engineers and member of the United States Commission of UNESCO. He thus described American engineers, and their contribution with engineers of all countries toward the rebuilding and unifying of the world:

"These active, practicing engineers, speaking the universal language of technology, and in most cases, the native tongues of the 80 countries where they are working, are thoroughly acquainted with these foreign engineers and their problems. These men represent the American point of view, wherever they are. They are co-operating with engineers of other nations in the modern techniques and practices. They contribute to the proceedings in their own societies and to the

technical literature which is accessible to all who are interested" (8).

Recently we observed in such large gatherings as that on Management in Stockholm in 1947, and Applied Mechanics in Paris in 1946, evidence of continued appreciation of values inherent in the international exchange of material on technical topics and problems. As this is written, plans are approaching completion for the first All-American Engineering Congress in which representatives of the professional societies of North and South America will meet at Rio de Janeiro in July, 1949.

5 Definite patterns in authorship constitute yet another influence upon the modern trend in technical publishing, whereby the valuable results of his colleagues' efforts can be made available to the scientist and engineer. Three distinct operations are visible: The first of these is the increasingly common practice of publishing in book form, private-experience records in engineering effort, manufacturing and research, so that this material is available to all. In a single period last year, for example, as the author reported in an article in the Argentine financial magazine *Veritas* (9), technical books were in press in one firm under authorship of experts on the staffs of such internationally known firms as du Pont, Goodrich, NBC, Pan-American World Airways, RCA, U. S. Steel, Westinghouse Electric, and Worthington Pump. The second is publishing as a co-operative effort on the part of large groups, where authorship includes government, professional societies, industry, and individuals, and distribution is typical of the free-enterprise system, i.e., by a commercial publisher. For example, the scientific interest of authors from many countries was reflected after World War I by the publication of the well-known 8-volume "International Critical Tables." Following the second World War, the U. S. Government sponsored, with the Radiation Laboratory of the Massachusetts Institute of Technology, the release of the results of wartime research on radar and related subjects. Five hundred scientists co-operated (many of them Europeans) on this 27-volume project. Circulation has been double the original estimates and 45 per cent has been made in foreign countries.

This type of group collaboration is climaxed currently in the National Nuclear Energy Series which the United States Atomic Energy Commission is releasing. This publication of international significance, which eventually will comprise 60 volumes, will cover the declassifiable research and development results obtained at all the major installations of the Manhattan District, U. S. Army Engineers, and the Atomic Energy Commission.[6]

The third operation is the "series" publications of whose importance technical publishers are becoming increasingly aware. While not novel in idea—witness the internationally known and distinguished Cambridge University Series—the practice is becoming a familiar one in the United States. The advantages of momentum and reputation under a skilled consulting editor are attracting authors in increasing numbers to produce on this basis.

6 The enormous increase in funds now being channeled for research purposes is giving and will continue to give undoubted stimulation to scientific and technical-book authorship. The trend can be followed by a study of Table 1.

7 The information libraries sponsored successfully by both British and American governments throughout the world

TABLE 1 PERCENTAGE DISTRIBUTION OF RESEARCH SUPPORT (10)

Sponsoring agency	1930	1940	1941–45	1947
Industry	70	68	13	39
Federal Government	14	19	83[a]	54[a]
Universities	12	9	2	4
Other (including states, etc.)	4	4	2	4
Total per year (in $ millions)	$166	$345	$600	$1160

[a] Not including atomic research.

unquestionably have made available to vast numbers of people, hitherto unexplored literature and sources for information. The author, after personal contact with a score of these institutions, testifies unreservedly as to their value in international relations. United States publishers, however, regard with envy their British colleagues, whose government has long recognized the value of overseas-information programs in international relations, and participates directly in the solution of distribution and cost problems faced by individual publishers. The relative attitudes of the two governments are demonstrated in the report (11) of the U. S. Congressional Committee after its visit to 22 European countries in the summer of 1947, for the purpose of investigating the existing information and educational exchange services abroad. In four typical cities (Stockholm, Prague, Copenhagen, and Milan) adjacent to the Iron Curtain, the United States had cut its staff in half, while Britain continued its operation in those same cities, with staffs five times as large.

8 The world-wide shift in bilingual class enrollments is another postwar phenomenon. The use of the English language is becoming increasingly universal—less and less is an American abroad handicapped by his notorious lack of linguistic ability. In Latin America, reports the British Council, there was a total enrollment of nearly 28,000 in English classes during the 1946-1947 period, while United States-sponsored groups totaled 46,000. The rapid growth of such classes is limited only by the shortage of teachers, according to State Department officials. Similarly, in the United States, postwar enrollments in foreign-language study, especially in Spanish and Russian, are reported to be at new high levels.

9 Another influence is developing from an acceleration of international student exchanges and two acts of the U. S. Congress, passed during 1948, will have direct bearing on the export trend of technical material. The first is the Fullbright Act which provides that funds resulting from sale of surplus United States property be used toward educational exchanges of one form or another. Under this agreement Great Britain, for example, will receive $1,000,000 in pounds. Moreover, agreements recently have been signed with Belgium, China, Burma, Greece, New Zealand, and the Philippines, and it is believed that this act will facilitate the exchange of thousands of students and researchers both to and from America.

The Smith-Mundt Act, which grew out of the 1947 Congressional investigating committee abroad, is similarly designed to make more effective use of a United States information and educational exchange program, and should result in the acceleration of an interchange of information in general on a world-wide basis.

10 Libraries also contribute to international exchanges. For example, as a direct outgrowth of the movement to restore libraries in devastated areas, the United States Book Exchange (12), composed of professional societies and library associations, has recently been organized to facilitate the exchange of duplicate volumes or institutional publications through a central clearing house for foreign and domestic material.

Distinct from this, yet equally valuable, is the new Farmington Plan (13) a co-operative project for securing foreign litera-

[6] The first volume, an 800-page tome, appeared in December, 1948, under the title, "Histopathology of Irradiation," by Dr. William Bloom, University of Chicago (McGraw-Hill Book Company, Inc.). Another striking example of professional-society and commercial-publisher collaboration is in the famous American Chemical Society Monograph Series, the 108th volume of which has just appeared under the title "Cobalt," by Roland S. Young (Reinhold Publishing Corporation).

ture for 52 research libraries. It provides that at least one copy of every foreign book published anywhere in the world of importance in research, be available in the United States.

11 Finally, and most gratifying, from the U. S. authors' and publishers' viewpoint, is the aid from official sources to bibliographical publications. One example is the *United States Quarterly Book List* which grew out of a Pan-American government agreement on the importance of exchanging publication information internationally. Now in its fifth volume, this periodical is prepared in the Library of Congress and published by the Rutgers University Press. It includes technology and the physical sciences among the 1000-odd titles that are described annually in its "highly selective bibliography and review of currently published United States books which are believed to make a contribution to the sum of knowledge and experience." Unfortunately the promised Latin American publications have not yet appeared.

Another example is the comprehensive *Bibliography of Scientific, Medical and Technical Books* edited by R. R. Hawkins of the New York Public Library, which the National Research Council, the State Department of the U. S. Government, and other agencies have sponsored or encouraged. Volume 2 covering the 4000 U. S. books published in the period 1945 to 1948, is scheduled to appear in 1949. Its success should be even greater than Volume 1 which appeared in 1946 and continues to be in demand throughout the world. The Yale University Press produced both volumes.

Similar evidences of the publishing programs in all countries of the world might well be accelerated by UNESCO with obvious gains for all persons and organizations concerned with the qualified and selected references to developments in technical literature.

RESPONSIBILITIES

The publishers of technical literature are facing new responsibilities in this postwar era of constantly changing techniques, of new developments in science and engineering, of freshly defined requirements in training of personnel for increased productivity, and of rapidly spreading demands for global circulation of the new techniques in engineering. Qualitatively the highest standards of accuracy must be maintained. Naturally, under competitive conditions, publishers will aim for the highest standards of authorship, clarity of presentation, format, and for reasonableness of price. Such obviously widespread interest should act as a spur to publishers to encourage translations in many languages, to secure book reviews in all qualified journals, regardless of language barriers, and to stimulate printers and binders to adopt new processes that serve to reduce costs.

Since a publisher's opinion of the value inherent in technical books may be suspect, the author will quote from a recent bulletin published by Stanford University (whose faculty members, including Terman on "radio" and Timoshenko on "mechanics" and related subjects, are known internationally) (14). It said:

"As with law and medicine, so with engineering, operation without books would be virtually impossible. Factual information from handbooks, condensed knowledge from reference books, better understanding from textbooks, the latest advances from technical periodicals—all these are necessary to the profession.

"The University, no less than the practicing engineer, requires full use of books. Students are entitled to the best in books. For engineering teaching, particularly for undergraduate courses, the faculty policy is to teach whenever possible from a textbook. Thus adequate coverage, uniformity of treatment, continuity, and good organization are assured."

At the present time the publishing industry and its producing authors are looking with eagerness and some impatience at the progress being made by UNESCO toward the success of its three-point program of international co-operation: (*a*) Preservation of knowledge, which is given the highest priority in the rehabilitation of libraries, museums, and educational institutions; (*b*) increase of knowledge, which is concerned with the development of conditions more favorable to the creative and investigative world of scholars; and (*c*) dissemination of knowledge through education and all instruments of communication.

In the field of the abstracting journals, where before the war the Germans had their Centralblatter, the British their Commonwealth Bureaus, and the North Americans their Biological Abstracts, the engineers in the United States started a pioneering postwar effort with the new *Applied Mechanics Reviews* (15). This is a critical review of the world literature which UNESCO officials might well point to as an example for other branches of technology to emulate.

It is reasonably safe to assume that on an international basis the public interest in technology was never greater. The challenge is now before all agencies to break down the legal, financial, and other obstacles which, whether stemming from wartime regulations or peacetime standards, are standing in the way of the freest of cultural intercourse. The resultant open access to the world's literature cannot but assist also toward increased world productivity and the raising of living standards of all peoples.

Lest it be thought here that the technical publisher takes himself too seriously, the writer hastens to quote the words of the author-scientist Linus Pauling (16), which he delivered before the Royal Institute in London:

"The basic answers to all these (scientific) questions are not to be found in books. Even though Chaucer had said:

'For out of olde feldes, as men seith,
Cometh al this newe corn fro yere to yere;
And out of olde bokes, in good feith,
Cometh al this new science that men lere,'

he was before long corrected by Francis Bacon:

'Books must follow sciences, and not sciences books.'"

PROBLEMS

How is it possible for the technical publisher to attain the ideal of world-wide circulation of his authors' ideas and methods? Is it possible for him to participate in the program UNESCO tried to bring nearer fruition recently in near-by Beirut?

Some of the practical problems which are beyond the control of the individual publisher are listed here as a reminder that much as he may be in sympathy with the highest aims of cultural interchange, governmental aid and co-operation are prerequisites for their solution:

(*a*) The international currency shortage, which acts as a definite break upon the continuance of postwar expansion of world-wide literature exchange; (*b*) laws of copyright, which still remain hazardous in many countries, although continuously improving as a protection of authors' rights; (*c*) the extremely low purchasing power in many countries, which permits importation for only a relatively small demand; (*d*) absence of international standardization of units of measurement which reduces the utility and increases the cost of translation of engineering books.

THE CHALLENGE

The publishing industry as a whole is faced by a challenge today which may be summed up in the words of the charter of

(*Continued on page* 223)

What's the Best Way to Tell Your Free-Enterprise Story to Your People?

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LARGE-SCALE ADVERTISING EXPERIENCES

MANAGEMENT for fifty years has discarded the idea the world will beat a pathway to the man who builds a better mousetrap than has ever been built before. As individualistic as was the late Henry Ford, he capitulated to large-scale advertising more than a quarter of a century ago.

At the turn of the century, management had good reason to question large-scale advertising and agency practices; for most advertising was based on hunches, swivel-chair opinions, and single-case personal experiences. The result was that millions of dollars annually were wasted on unproductive advertising.

To increase the productivity of advertising appropriations several developments paralleled the technical developments of typography, layout, and media. These were (1) testing results after a campaign was completed;[1] (2) pretesting results on a small scale in a representative market and correlating end results; (3) the practical application of the psychology of the "over-act."

Unfortunately, too much time and money are now spent on "patent medicine" advertising to employees and not enough on such direct participation as that just indicated. On the periphery of this psychological approach are the various foremen's training programs in which foremen are expected to take a part in and put to use the ideas discussed in their classes or meetings.

TYPICAL COURSE ON FREE-ENTERPRISE ECONOMICS IS TOO SHORT AND TOO SHALLOW

Is it not, however, asking too much of a foreman to explain to his people the fallacy of gearing wages to living costs after four one-hour lessons in economics? It is asking too much for several reasons. In the first place, wages, prices, costs, taxes, tariffs, overhead, ad infinitum, are so interrelated that no foreman, however brilliant, could get his economic thinking straight in such a short time—even under the guidance of the best teacher.

The foreman and a company underestimate the size of the job to be done when the attempt is made to put the rank and file straight on economic truths in four, ten, or even twenty one-hour lessons.

The job must be done on a broad company-wide basis. Obviously, employees cannot be asked to send in letters on "Why the Company Can't Retire Me at Two Hundred Dollars a Month at the Age of Sixty." Indeed, if the employee knows the simple economic facts of life, he will be more reasonable in his demands on a company which tries to do the right thing.

APPLYING ADVERTISING TECHNIQUES TO FREE-ENTERPRISE STORY

How, then, can employees—up and down the line—learn and believe in simple economic truths? The answer seems to be simple if we borrow some of the advertising man's technique.

1 It is necessary to generate a game or competitive spirit in this educational program. Attendance at "lectures" should be voluntary—after hours (preferably Saturday morning) and on the employee's own time. Any cash awards given (and there should be liberal awards) should total no less than $1.00 per hour times the number of man-hours of class attendance.

2 Such a program or course should include everyone who wishes to participate—the floor sweeper as well as the president.

3 Because of the controversial nature of many economic facts and theories, the course should be put on by some outside specialist—someone not connected with the company. Indeed, the outside instructor might be chosen jointly by the company and the union, and his part-time salary paid jointly by both parties.

4 Cash prizes should be given to the upper 25 per cent in each of the following classes: (*a*) Noncollege supervisory personnel; (*b*) people having more than two years of college work; (*c*) hourly rated people; and (*d*) salaried personnel not falling in any of groups (*a*), (*b*), or (*c*). Obviously, no one should be eligible for two prizes in case he happens to fall into two groups.

5 Once an outside instructor is engaged, he should be told in the presence of union officials that he is to teach orthodox economics from any one of the five leading college texts in elementary economics.

6 Two one-hour sessions per week for two fifteen-week "semesters" would probably result in the optimum understanding of economic principles. The first hour might be a large lecture session; the second hour might be broken down into discussion groups of fifteen to thirty students with a competent person in charge of each.

7 Learning indexes must be established. Such an index might be obtained by giving the final examination (objective)

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[1] There are at least half a dozen ways in which development (1) is tested, perhaps the best being the sales ranking of an advertiser compared with his competitor. The pilot-plant idea is used in (2), wherein a city, county, or state is used as a guinea pig, the final campaign being changed to conform to the results of this local test. Development (3) has been the latest and perhaps the most effective technique used up to date; getting reader or audience participation in your product or company name; for management has come to realize unless some tangible expression is made by "potential" customers, they never will become "customers!" Hence box tops, walking men, and other ideas have taken the center of the advertising stage in recent years. The peculiar part is that these contests are frequently the subject of serious conversation in some rarefied society.

Not the first but surely one of the largest and perhaps best-conducted "employee-attitude" contests used this potent psychological over-act principle. General Motors, in an attempt to get its employees to think positively about the company, conducted an employee letter-writing contest, "My Job and Why I Like It." No limit was put on the number of words nor were letters to be judged for literary style but for sincerity and content. Five nationally known men were selected as judges, and thousands of dollars' worth of General Motors products were given away to the prize winners. Results: 174,854 General Motors employees entered the contest, or something like 50 per cent of the total pay roll—a sizable total and an impressive percentage. A 176-page General Motors booklet, "M. J. C.—Accentuating the Positive" gives many of the details of this contest as well as the forty grand-award winning letters.

at the first class meeting. Some explanation might be made, such as, "I'd like to know just how deeply I should go into this subject so I am going to ask you a few questions tonight that will help me plan this course." The students of course do not know that this will be the identical examination they will receive fifteen weeks hence. But the professor and top management will have some idea of just how much economic knowledge was gained from the course by comparing the median-class grades at the beginning with those at the end of the course. Need it be said that no one besides the instructor and the student will ever know what any individual student's grade is excepting the upper 25 per cent in each of the four categories previously listed.

RESULTS AND CONCLUSIONS

Thus, under the proper conditions, not only would union stewards and their constituents learn a lot about economics but it is possible the people who conceived the course (management) would learn some too (e. g., that tariffs really lower the scale of living of over 90 per cent of any population; that a reduction in personal income taxes during an inflationary spiral adds fuel to the price flame; that the volume of money and credit have a far greater effect on prices than do wages; ad infinitum).

But more important than the learning process that would go on under the proper class leadership would be the refreshing experience of management meeting on the same level with stewards and others who during the day have a difficult time seeing eye to eye on the very things discussed in the economics class. Indeed, unless the "professor" was very careful he would spend half his time arbitrating plant differences which had occurred earlier in the week.

For this and other reasons a high-grade man commanding \$15.00 to \$25.00 a classroom-hour should be employed—a man who will have a host of friends at the end of the course (on "both sides of the fence"). Such a teacher would give everyone a better understanding of the "socio-eco-politico" factors which make a competitive society work. Above all, he would convince 90 per cent of the class why a free competitive society gives the greatest number of people the greatest good and happiness. Every community of 50,000 population or more has at least one such stimulating and learned man whom business and labor could trust to put out an objective course—to clarify these economic principles which cause so much trouble in business today because they are not fully understood by both labor and management.

It is hoped that this article will set into motion one or more sincere attempts at learning what really does make our economy tick. It cannot be done in "four easy lessons." It cannot be done (easily) during working hours. It cannot be done (well) by a company-paid full-time instructor. It cannot be done on a compulsory-attendance basis. It must be dramatized. It must be objective.

Let us stop wasting millions of dollars annually by redirecting at least half of our house organ, newspaper, direct mail, and other employee-directed advertising to large and small-scale discussion groups led by competent and objective thinkers.

Technical Literature

(*Continued from page 221*)

the Engineers' Council for Professional Development, representing the memberships of seven societies in the United States and Canada, and a total membership of over 100,000. With a broad conception of service which implies acceptance of social responsibility, as well as technical competence, it is their aim ". . to co-ordinate and promote efforts and aspirations directed toward higher professional standards of education and practice, and greater effectiveness in dealing with technical, social, and economic problems."

Although the current inflationary trend in the United States presents a problem for the publisher of technical books, the development of new book-manufacturing processes and the expansion of technical-book markets should tend to lessen any marked danger to the industry as a whole. And the publisher is under constant pressure to publish the results of: (*a*) The many new research programs; (*b*) constantly improving teaching and manufacturing methods; and (*c*) the efforts of individuals in the free-enterprise system. He is additionally challenged, as are his authors and their readers, by the increase in the number of libraries throughout the world, and by the improvement in bibliographical exchanges.

"Freedom of information," as proposed in the General Assembly of the United Nations and agreed upon by a majority in the conference at Geneva during the spring of 1948, must remain at the masthead of technical as well as general publishers. Universal international agreement is the ideal.

In summation, let the author repeat that the potential international influence of technical literature has undoubtedly never been greater. The sponsors face an unprecedented challenge to overcome all economic, political, or manufacturing barriers, and to exert the maximum of beneficial influence upon standards of living and the happiness of peoples throughout the world.

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PATENTS *and the* COURTS—
REFORM *or* REVOLUTION?

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INTRODUCTION

It is axiomatic that the patent system of the United States, designed to protect the fruits of the engineering, scientific, and inventive brains of our country, has been one of the cornerstones of our industrial success. The statistical record shows clearly that the industrial prosperity of any nation is indisputably connected with the extent to which patent rewards are granted to stimulate invention and to protect the results commercially.

Engineers have a primary stake in the patent system; not only in the creation of new engineering developments, but in their continued employment and mass production. Without the patent weapon much of the justification for the engineers' work in the eyes of those who employ them would disappear; therefore they have a deep personal interest.

As patents are the foundation and protection of the creative side of American industry, providing an expanding economy and opportunity under constitutional mandate, a clear knowledge of what has been done to our capitalistic system is essential.

Although our patent system is based on the sound foundation of a constitutional provision provided by our governmental founders for the protection of invention, we find ourselves at this time confronted with a serious threat to this foundation of our prosperity.

The socioeconomic program in relation to patents, and the reformation of the patent laws by judicial instead of by legislative process has made a sweeping change in the whole patent system. This message records what has occurred factually. Whether it is for the benefit of the nation or not, and whether the Supreme Court of the United States has gone beyond its constitutional authority in this revolutionary reformation and destruction of established patent rights, as interpreted by our courts universally for more than a century, are matters for the reader to decide.

That there has been a revolutionary and wholesale change of practically every established concept of patents and the patent law is universally agreed.

NATURE OF THE PATENT RIGHT

Let us turn to a consideration of some of the broad rights heretofore accorded to a patentee, and then to a consideration of to what extent these rights have been taken away from him by judicial pronouncement—not by the orderly process of law as enacted by his duly constituted legislative representatives.

In this connection will be recalled the exhaustive investigations by Congress under the Temporary National Economic Committee as to patents, their enforcement, and their economic consequences. Doubtless it will come as a surprise to learn that Congress decided to do nothing about the patent system, being completely satisfied with it, but that it is the Supreme Court of the United States which repeatedly has referred to these proceedings and cited them as a basis for its patent reform.

LAWS OF NATURE AND SCIENTIFIC DISCOVERIES

Before proceeding to the more revolutionary socioeconomic decisions on the commercial handling of patents let us examine a case, decided this year by the Supreme Court of the United States [Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U. S. 127, 1948, Mr. Justice Douglas] on the question of whether patents which monopolize the laws of Nature and scientific discoveries can be sustained as valid.

In view of the vast amount of public and private research of fundamental character upon which all industry depends and upon which our national defense must be founded, we realize that this decision in Funk v. Kalo went to the very heart of our patent system. The Supreme Court wisely decided that the wellsprings of science, of research, and of invention in the fundamental things which are the laws of Nature are not susceptible of private monopoly. Scientific discoveries and the results of pure research now remain outside of the domain of commercial monopoly.

Probably no single decision of the Supreme Court of the United States is of greater public and industrial importance than this one, which finally demarks the world of science as outside the boundary of private monopoly.

STANDARD OF INVENTION

The standard of invention now established by the Supreme Court of the United States has been the most revolutionary of all of the new doctrines changing the patent laws.

In the Cuno case [Cuno Corp. v. Automatic Devices Corp., 314 U.S. 84, 1941, Mr. Justice Douglas] the Supreme Court held that no invention was worthy of a patent unless it was the result of some sudden brain storm, known as a "flash of genius." The fact that no one has been able to define a flash of genius merely complicates the situation.

If this be the true test of invention—which later decisions of the Supreme Court seem to doubt—then the composite results of modern industrial research, great engineering departments, and the organized attack of engineering and science upon the solution of problems resulting in invention will be completely discarded. Only the man with the "quickie" idea who has an intellectual hunch will be entitled to a patent.

So extraordinary is this pronouncement that I venture to quote it from the opinion of the Court:

> ". . . That is to say, the new device, however useful it may be, must reveal the flash of creative genius, not merely the skill of the calling. If it fails, it has not established its right to a private grant on the public domain." [314 U. S. 84, 91.]

The lower courts have shifted their standard of invention because of the stiffened attitude of the Supreme Court respecting inventiveness. Judge Learned Hand of the Second Circuit Court of Appeals has said that it is as much the duty of a lower court to give effect to the change in the standard of invention

Contributed by the Machine Design Division and presented at the Annual Meeting, New York, N. Y., November 28–December 3, 1948, of The American Society of Mechanical Engineers. Paper No. 48—A-49.

adopted by the Supreme Court as it is its duty to give effect to any other of the decisions of that court. [Foxboro Co. v. Taylor Instrument Companies, (CCA 2) 157 F.(2d) 226, 234, 1946. Cf. Brown & Sharpe Mfg. Co. v. Kar Engineering Co., (CCA 1) 154 F.(2d) 48, 51; Cleveland Punch & Shear Works v. E. W. Bliss, (CCA 6) 145 F.(2d) 991, 1944, Simons, C.J.; Picard v. United Aircraft Corp., (CCA 2) 128 F.(2d) 632, 636, 1942, L. Hand, C.J.

The Court of Customs and Patent Appeals has said:

"In our opinion it is not within the province of the courts to establish new standards by which invention is to be determined. It seems clear to us that the creation of new standards for the determination of what constitutes invention would be judicial legislation and not judicial interpretation.

"It follows, from the foregoing, that until Congress shall otherwise legislate, or the Supreme Court shall otherwise specifically hold, this court will continue to hold that if a process or thing constitutes patentable subject matter, is new and useful, and the process performed or thing produced would not be obvious to one skilled in the art, invention would be presumed and a patent may properly issue therefor."

In re Shortell [(CCPA) 142 F.(2d) 292, 294, 1944, Lenroot, Associate Judge].

CONTRIBUTORY INFRINGEMENT: PRACTICAL ENFORCEMENT OF PATENT RIGHTS

In our increasingly complex industrial manufacturing scheme, it has become more and more necessary for manufacturers to specialize. Few manufacturers can follow the European practice of making substantially everything they need in their own plants. Consequently, most owners of patents manufacture and sell only a part of their patented combinations, leaving the purchaser to add the part to their existing machines or to their products.

For instance, in the business of manufacturing trucks with dump bodies, the logical commercial arrangement has been that the chassis is manufactured by a truck manufacturer who may or may not make the bodies, and a number of very substantial concerns have developed highly specialized body businesses, selling bodies to the truck manufacturers who in turn sell the whole combination to the trucker.

The courts now hold that if the patentee is unfortunate enough to have his claims read in the normal manner on the combination of the truck and the truck body in which the novelty is primarily in the body, he is guilty of misuse of his patent and will lose it because economically he sells only the body. He cannot enforce his patent. [Galion v. Budd, (CCA 3) .... F.(2d) ...., June 30, 1948, McLaughlin, C.J.]

This extraordinary, and what seems to many unjust and impractical, rule is founded upon a group of recent Supreme Court decisions dealing with the doctrine of contributory infringement and the use of a patent to control the use of an unpatented part or unpatented material.

Contributory infringement occurs when an infringer sells less than the whole patented combination, but with the knowledge and intent that what he sells shall be used to complete the combination covered by the patent. Under our methods of manufacturing this has become the usual case of patent infringement.

In the case of the truck-body manufacturer who held the patent on the combination of the body and the truck, he was unable to stop his competitors from infringing his patent when they took the complete invention, because his attorney many years ago had followed the usual rule of saying in the claim that the truck body was a part of the combination with a truck chassis.

In the Supreme Court we find equally interesting departures from the realm of the requirements of industry, because patents are of no value unless they aid manufacturing and distribution, and unless they can be enforced to protect those who own them from unlawful competition.

In the Carbice case [Carbice Corp. v. American Patents Corp., 283 U. S. 27, 1931, Mr. Justice Brandeis] the owner of a patent for a combination of a container for ice cream and dry ice was in the only profitable phase of that business, that is, selling dry ice. When he endeavored to get the benefit of his patent by trying to prevent others from selling dry ice for use in his cheap ice-cream containers, he was told that that was illegal, and that, while the intent to complete the combination of his special container was clear, his competitor could take all the advantages of his patent and infringe on it in the only way that was profitable, doing so with impunity.

This changed the rule of Leeds & Catlin (No.2) [Leeds & Catlin Co. v. Victor Talking Machine Co., (No.2) 213 U. S. 325, 1909, Mr. Justice McKenna] which had been the law of the land for many years as established by the Supreme Court itself.

In that case a patent on the combination of a phonograph and a record was enforced against an infringer who made the profitable item of replacement records for use in the combination of phonograph and record.

In the recent Mercoid cases [Mercoid Corp. v. Mid-Continent Corp., 320 U. S. 661; Mercoid Corp. v. Minneapolis-Honeywell Regulator Co., 320 U. S. 680, 1944, Mr. Justice Douglas], the right of stopping contributory infringement has been virtually destroyed.

In these cases the patent covered a domestic heating system which comprised three main elements: a motor-driven stoker for feeding fuel to the furnace; a room thermostat for controlling the feeding of this fuel; and a combination stoker switch to prevent extinguishment of the fire. The heart of the combination, or system, patent was the thermostat, which functioned to supply or discontinue the heat by controlling the circuit to the stoker to make it function at the required temperatures. There was no use for the switch supplied by the defendant to this combination other than in the patented combination, so that it was undoubtedly contributory infringement.

The manufacturers opposed to one another were competitors in the business of making switches only and were not making complete stokers, because economically they specialized in switches to give the public the finest possible switches, and the stoker manufacturers specialized in the making of stokers. Such is our customary industrial organization to which patents must be adapted if they are to be of practical value.

The Supreme Court said that even though the validity of the patent was assumed; that even though the competitor did not act innocently; that even though the switch had no other use, was manufactured for use in the patented combination, and represented the only profitable source of income from the patent for the switch manufacturer who owned it, the patentee could not stop the infringement because of misuse of the patent for the purpose of monopolizing unpatented material.

What is left of the right to stop those who so invade patent rights is a grave question.

FUNCTIONAL CLAIMS AT THE EXACT POINT OF NOVELTY

The Halliburton case [Halliburton Co. v. Walker, 329 U. S. 1, 1946, Mr. Justice Black] has been the subject of much discussion because of its holding concerning expressions of functionality in claims, but the conclusion reached by the Supreme Court seems consistent with earlier rulings. [Cf. Holland Furniture Co. v. Perkins Glue Co., 277 U. S. 245; General Electric Co. v. Wabash Appliance Corp., 304 U. S. 364; United Carbon Co. v. Binney & Smith Co., 317 U. S. 228.]

The law requires a "full, clear, concise, and exact" description of the claimed invention. [R.S. § 4888, 35 U.S.C. § 33.] "Functional" claims are claims which describe the invention in terms of what it will do, rather than in terms of its own physical characteristics or its arrangement in the new combination apparatus. It is the habit of many lawyers to attempt to go beyond the invention and to claim it in terms of function rather than in terms of specific structure. The courts look with disfavor upon claims where the particular point of novelty is that which is described in terms of function.

Engineers can well appreciate the soundness of the reasoning of the Court when it said:

". . . In this age of technological development there may be many other devices beyond our present information or indeed our imagination which will perform that function and yet fit these claims. And unless frightened from the course of experimentation by broad functional claims like these, inventive genius may evolve many more devices to accomplish the same purpose. . . ." [329 U. S. 1, 12.]

WHEN DOES A PATENT BECOME INVALID UNDER THE STATUTORY TIME RULE?

A patent is invalid if there has been public use or sale of the device which it covers more than one year before the filing of an application in the Patent Office. [Prior to August 1, 1940, the period was two years.]

In the Outboard Motor case [Muncie Gear Works v. Outboard Marine & Mfg. Co., 315 U. S. 759, 1942, Mr. Justice Jackson], the statutory rule has been amplified to the extent that claims directed to a subject placed in the patent application by amendment for the first time more than one year after a public use or sale are invalid, even though the original application was filed within the regular statutory period.

Therefore it is important that an original application contain every possible disclosure of the invention in order to obtain patent protection.

THE REQUIREMENT THAT BOTH VALIDITY AND INFRINGEMENT BE DETERMINED BY THE COURT IN AN INFRINGEMENT SUIT

There can be no infringement without a valid patent. Therefore in an infringement suit both the question of infringement and that of validity are issues. In the past the tendency of the trial courts has been to decide, where possible, on the ground of noninfringement without going into the question of validity.

In the Sinclair case [Sinclair Co. v. Interchemical Corp., 325 U. S. 327, 1945, Mr. Justice Jackson], the Supreme Court said that of the two questions validity has the greater public importance and pointed out that the trial courts should inquire fully into the validity of the patents in suit.

In view of this decision the trial courts now usually make a finding as to both infringement and validity. When this is done, a complete record is available in case an appeal is taken, saving time and expense both for the litigants and for the courts.

THE RIGHT TO PATENT A COMPLETE MACHINE WHEN ONLY IMPROVEMENTS HAVE BEEN ADDED

Claims to an improvement of a previously patented article must be restricted to the improvements. In describing the invention it may be necessary to make reference to certain portions of the device in connection with which the new combinations are to operate, but, unless an attempt is made to embody the previous device in the improvement patent, it is valid. [Williams Co. v. Shoe Mach. Corp., 316 U. S. 364, 1942, Mr. Justice Roberts.]

ETHICAL REQUIREMENTS FOR INVENTORS AND MANUFACTURERS DEALING WITH PATENTS

The Supreme Court has made a fine contribution to the ethics of patentees in a series of cases starting with Keystone Co. v. Excavator Co., [Keystone Driller Co. v. General Excavator Co., 290 U. S. 240, 1933, Mr. Justice Butler].

In that case the owner of the patents made a corrupt bargain to suppress evidence that would have shown one of the patents of a group was invalid. The Court refused to enforce any of the patents of this patent owner and sent him away empty-handed.

More recently, in the case of Precision Co. v. Automotive Co., [Precision Instrument Mfg. Co. v. Automotive Maintenance Machinery Co., 324 U. S. 806, 1945, Mr. Justice Murphy], the Supreme Court denied relief to an owner of a patent because, while the patent applications upon which the patents were granted were pending in the Patent Office and were subject to Patent Office proceedings, the owner of the patent failed to report all the facts to the Patent Office, concealing possible fraud or inequitableness underlying the applications.

In this case a settlement of an interference proceeding by the competing inventors as to who was to get the patent was settled with knowledge or reasonable belief of perjury not revealed in the Patent Office, and therefore the issuance of the patent was gained by fraud.

The Court said that the failure of counsel and the patentee to carry out their uncompromising duty was not excused by reasonable doubt as to the sufficiency of the proof of the inequitable conduct or even by resort to independent legal advice.

It therefore behooves patentees and their counsel to report anything that may affect the legitimacy of any patent application while it is pending in the Patent Office.

In an earlier case [Hazel-Atlas Glass Co. v. Hartford-Empire Co., 322 U. S. 238, 1944, Mr. Justice Black], the Supreme Court held that the securing of a patent by inducing the publication of fraudulent technical articles which mislead the Patent Office would result in complete defeat of the patents involved.

[Cf. Root Refining Co. v. Universal Oil Products Co., (CCA 3) . . . F. (2d) . . . , 78 USPQ 95, decided July 6, 1948, in which directions were given to the District Court to vacate judgments entered more than ten years earlier and to dismiss the suits by reason of fraud practiced upon the court.]

MISUSE OF PATENTS

A relatively recent rule which has been established by the Supreme Court of the United States deprives unwary patent owners of all the rights under their patents because of an alleged "misuse." Misuse appears when the owner of the patent endeavors to protect those mechanisms which he manufactures and sells from competition because those elements constitute his only chance for profit from his patented combination.

Returning to the controversy over the stoker regulator switch [Mercoid cases] the Supreme Court defeated the rights of the owner of the patent on the combination of the stoker and switch, because the patent owner used his patent to control competition by way of license in the sale of the switch. The attempt to enforce the patent was rejected even though the switch was the distinguishing part of the invention of the patent owned by the switch manufacturer and even though the manufacturer was licensing his competitor so both could broaden the use of the switch for the public benefit.

In another case [Standard Register Co. v. American Sales Book Co., (CCA 2) 148 F.(2d) 612, 1945, A. Hand, C. J. Cf. International Business Machines Corp. v. United States, 298 U. S. 131, 1936, Mr. Justice Stone], a manufacturer of business machines which employed a special type of paper was denied the right to enforce a large group of patents because, when he

licensed his expensive platens for mounting upon typewriters, he made the simple requirement that he should get at least a few dollars worth of paper business to compensate him for the use of his patented device which he leased for a nominal rental.

This doctrine has been expanded so that in many cases a vast number of patents have been emasculated on the theory that any attempt by the owner of a combination patent to license or otherwise control the main subject of the patent owner's business, if he does not make the entire patented combination, will result in a misuse of his patents; and he will be denied any right to enforce them either against the user of the complete combination or of the essential part of it from which the patentee and his competitors derive their profit. [International Salt Co. v. United States, 332 U. S. 392, 1947, Mr. Justice Jackson; Morton Salt Co. v. G. S. Suppiger Co., 314 U. S. 488; Mercoid Corp. v. Mid-Continent Investment Co., 320 U. S. 661; Mercoid Corp. v. Minneapolis-Honeywell Co., 320 U. S. 680.]

A patentee has no right to control the sale of unpatented materials, such as paper cards in an IBM tabulating machine [International Business Machines Corp. v. United States, 298 U. S. 131, 1936, Mr. Justice Stone], or continuous stationery in a business accounting or typewriting machine, [Standard Register Co. v. American Sales Book Co., (CCA 2) 148 F.(2d) 612, 1945, A. Hand, C.J.], or salt tablets in a salt-tablet dispensing machine [International Salt Co. v. United States, 332 U. S. 392, 1947, Mr. Justice Jackson; Morton Salt Co. v. G. S. Suppiger Co., 314 U. S. 488, 1942, Mr. Chief Justice Stone], or chemical glues in a glue machine for shoes, or the like. [United Shoe Machinery Corp. v. United States, 258 U. S. 451, 1922, Mr. Justice Day.]

Thus the rule is that a patent monopoly may not be extended to cover either unpatented materials or patented materials covered by another patent. [Ethyl Gasoline Corp. v. United States, 309 U. S. 436, 1940, Mr. Justice Stone.]

RIGHTS UNDER LICENSES AND CROSS-LICENSES

If there is one thing that would seem to justify the patent system and which would promote competition and prevent monopoly, I should say it is the right of a patentee to rent rights under his patents by way of licenses to his competitors. In this way the public can secure the benefit of the research and engineering work of many concerns, so that a single piece of apparatus will embody the best inventive and technical plans. Without cross-licensing of patents the purchasing public might be offered one piece of apparatus having certain new features and another piece of apparatus having other new features, but one piece of apparatus having all of the new ideas incorporated in it would not be available. This latter result comes from cross-licensing of patents.

But this right has been struck a serious body blow by recent Supreme Court decisions. [United States v. Line Material Co., 333 U. S. 287, 1948, Mr. Justice Reed; United States v. U. S. Gypsum Co., 333 U. S. 364, 1948, Mr. Justice Reed.] For many years the right to license, together with the right to protect the licensor—owner of the patent—from unrestricted and unfair competition of the licensee, has been recognized by the Supreme Court. [Bement v. National Harrow, 186 U. S. 70, 1902; United States v. General Electric Co., 272 U. S. 476, 1926.]

One of these rights was for the licensor to specify the price at which the licensee would sell the patented product. This was necessary to encourage licensing, because otherwise the owner of the patent would merely authorize for a small fee a competitive manufacturer—who had no expense in the engineering and development work to amortize—to come into his field, cut the price, and ruin his business. It is still the law of the United States that this right to control the price of the licensee by the licensor exists under the General Electric case. [United States v. General Electric Co., 272 U. S. 476, 1926, Mr. Chief Justice Taft.]

Sale of a patented article exhausts the patent monopoly, hence the patentee cannot control the resale price of patented articles which he has sold. [Bloomer v. McQuewan, 14 How. 539; Bauer & Cie v. O'Donnell, 229 U. S. 1; Boston Store v. American Graphophone Co., 246 U. S. 8; Straus v. Victor Talking Machine Co., 243 U. S. 490; Ethyl Gasoline Corp. v. United States, 309 U. S. 436; United States v. Univis Lens Co., 316 U. S. 241.]

In the Univis Lens case [United States v. Univis Lens Co., 316 U. S. 241, 1942, Mr. Chief Justice Stone], the licensor sold an unfinished product which embodied essential features of the patent and was without utility until finished in accordance with the patent. The Court held the licensor could not control the price at which the product was sold by the licensee either in the unfinished or finished form.

Recently, the Supreme Court has gone further. In the Line Material case [United States v. Line Material Co., 333 U. S. 287, 1948, Mr. Justice Reed], the Court held that patent owners could not combine their patents and cross-license one another with sale-price restrictions, even when such combination of patents was essential for the production of the best embodiment of the desired product.

In other words, as a licensor you can still tell the licensee the price at which he may sell, but, if you have a cross-license, then the price-control feature is illegal. This, the Court said, was a violation of the antitrust laws as a scheme to agree on prices under the guise of a patent license. Here was a case where two corporations each had patents and "only when both patents could be lawfully used by a single maker could the public or the patentees obtain the full benefit of the efficiency and economy of the inventions." [333 U. S. 287, 291.] When these manufacturers stipulated that neither would cut the price of the other, it was held to be a conspiracy to restrain trade. Therefore this practical solution of a patent deadlock was held to be illegal.

In the companion Gypsum case [United States v. U. S. Gypsum Co., 333 U. S. 364, 1948, Mr. Justice Reed], an even more unusual result was arrived at by the Supreme Court. U. S. Gypsum had a patent under which it had controlled the prices of licensees for many years. When that patent expired, it had acquired another patent. It made the same arrangement, but went further and tried to restrict the sale and pricing of the subject matter of its expired patent. This, the Court held, in view of the extensive licensing system involved, was a violation of the antitrust laws by having an entire industry acting in concert to fix prices and control sales in unison. From a practical point of view, as the subject matter of the expired and unexpired patents had to be sold together, the manufacturers of gypsum board found no practical way of operating under a price control by licensing if that control were violated by cheating on the unpatented board.

The right to cross-license is still retained but there must be no price control when there is a cross-license.

A licensor may require that the licensee assign his patentable improvements and, if he does not do so, the provision is enforceable in the courts. [Transparent-Wrap Machine Corp. v. Stokes & Smith Co., 329 U. S. 637, 1947, Mr. Justice Douglas.]

The Court pointed out in the Transwrap case that Congress has made all patents assignable and has granted the assignee the same exclusive rights as the patentee. [R.S. § 4898, 35 U.S.C. § 47.] The statute does not limit the consideration which may be paid for the assignment to any species or kind of property. Inasmuch as a patent is a species of property giving the patentee an exclusive right (the right to make, use, and vend the inven-

tion) that right is of the same dignity as any other property and may be used to purchase patents.

The Court referred to the Hartford-Empire case [Hartford-Empire Co. v. United States, 323 U. S. 386, 324 U. S. 570, 1945, Mr. Justice Roberts], as an illustration of how a condition in a patent license that the licensee will assign improvement patents may give rise to violations of the antitrust laws, but held that the condition is not per se illegal and unenforceable.

ESTOPPEL

In the event a licensor attempts to protect his patent position by a price-fixing arrangement under his license, he must then sacrifice a provision in the contract that the licensee is estopped from challenging the validity of the patent. Heretofore that provision has been considered essential in patent-license agreements because few patent owners would wish to give a competitor the benefit of patents and research, let him cut the price, and be perfectly free to say the patents were invalid. If the patent were sustained as valid, the competitor would still have the benefit of the license. [Katzinger Co. v. Chicago Mfg. Co., 329 U. S. 394; MacGregor v. Westinghouse Co., 329 U. S. 402, 1947, Mr. Justice Black.]

Here again, is another decision which seriously affects the commercial value of patents. As Mr. Justice Frankfurter said in his dissenting opinion, "It is one thing to refuse to enforce a contract restraining trade by price-fixing unless positive justification is shown in the form of a valid patent. It is quite another to use the excuse of an inoperative price-fixing clause to allow a licensee to escape his otherwise valid promise to pay royalties." [MacGregor v. Westinghouse Co., 329 U. S. 402, 408, 412.]

In 1924 the Supreme Court held [Westinghouse v. Formica, 266 U. S. 342, 1924, Mr. Chief Justice Taft] that an assignor of a patent right is estopped to attack the validity of the patent as against anyone claiming the right under the assignment. This would seem to be in accord with all the principles of good faith and fair dealing.

In the Scott Paper case [Scott Paper Co. v. Marcalus Co., 326 U. S. 249, 1945, Mr. Chief Justice Stone], the inventor-employee assigned his invention to his employer. Later he organized a company which competed with his former employer. When he was sued for infringement by the assignee of his patent, he defended on the ground that the alleged infringing device was that of a prior-art expired patent.

The Supreme Court held that the application of the doctrine of estoppel so as to foreclose the assignor of a patent from asserting the right to make use of the invention covered by an expired patent which anticipates that of the assigned patent is inconsistent with the patent laws, which dedicate to public use the invention of an expired patent.

Thus the age-old rule of all courts that one who sells something cannot later say it was worthless, because that would be dishonest, was changed. Such a decision results in it now being legal to say to the Patent Office, "I have made an invention;" then to obtain a patent and sell it; after which to go into competition with the new owner, and if he sues for infringement say, "I invented nothing; the patent I sold you was worthless; I propose to use what I sold you and not pay a cent for the privilege and further to invalidate the patent which I sold you."

INTERNATIONAL AGREEMENTS UNDER PATENTS

In these days of international transactions and world trade, one of our principal handicaps in international commerce has been the complicated patent situations throughout the world whereby groups of patents held by various nationals of different countries overlapped and conflicted.

Practical businessmen in such a situation repeatedly have arrived at agreements with their international competitors, by which they agreed to exchange patent licenses in their respective countries and in various countries where there were overlapping or conflicting patents. Under such agreements provision for exchange of technical information, exchange of inventive ideas, regulation of prices in international markets, and other commercial details for protection of the business have become customary.

In recent years the Supreme Court of the United States, by a series of decisions followed by the lower courts, has applied the antitrust laws of the United States, both as to domestic and international commerce, and has invalidated a number of such international agreements.

The latest of these cases was the National Lead case [United States v. National Lead Co., 332 U. S. 319, 1947, Mr. Justice Burton], in which the facts were as follows: Agreements had been entered into by a number of United States and foreign groups, pooling patents on titanium, accompanied by an allocation of markets. These agreements resulted in their patents being used to control the sale of manufactured titanium products in the United States.

The Supreme Court held that contracts under the guise of patent licenses to divide sales of manufacturing territories, to allocate markets, to limit or prevent United States imports or exports, to keep any party out of the market, or to give anyone an exclusive territory, were violations of the antitrust laws.

THE ANTITRUST LAWS AND THE PATENT LAWS: THE AREA OF AN AGE-OLD CONFLICT THAT PROMISES TO DESTROY THE PATENT SYSTEM

In 1832, Mr. Chief Justice Marshall said [Grant v. Raymond, 6 Pet. 218, 1832, Marshall, C.J.]:

". . . it cannot be doubted that the settled purpose of the United States has ever been, and continues to be to confer on the authors of useful inventions an exclusive right in their inventions for the time mentioned in their patent. It is the reward stipulated for the advantages derived by the public for the exertions of the individual, and is intended as a stimulus to their exertions. The laws which are passed to give effect to this purpose ought, we think, to be construed in the spirit in which they have been made; and to execute the contract fairly on the part of the United States, where the full benefit has been actually received, if this can be done without transcending the intention of the statute, or countenancing acts which are fraudulent or may prove mischievous. The public yields nothing which it has not agreed to yield, it receives all which it has contracted to receive. The full benefit of the discovery, after its enjoyment by the discoverer for fourteen years, is preserved, and for his exclusive enjoyment of it during that time the public faith is pledged. . . ."

Today these one-hundred-and-sixteen-year-old words of the great jurist seem to me to be a fair, sound statement of the rights of a patentee. However, as shown by the decisions discussed in this paper, during the last decade the Supreme Court of the United States has more and more restricted or completely denied enforcement of patents because of alleged "misuse" or conflict with the antitrust laws.

"The public faith is pledged"—has the Supreme Court kept that pledge?

CONCLUSION

Engineers and manufacturers would do well to ponder these sweeping changes which have been touched upon here, in connection with their rights and privileges under the patent laws of the United States. It would seem that many of these decisions were properly within the province of Congressional legislation and not judicial determination.

Despite the countless bills introduced into Congress by the

(*Continued on page* 233)

The Role of SCIENTIFIC MANAGEMENT *in World Recovery*

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THE world in which we live today is seriously ill. It has passed through one crisis, but no one can be sure that another still more critical does not lie ahead. To speak of world recovery, therefore, may seem somewhat premature, yet certainly recovery is necessary, and it must happen quickly if we are to have the strength to meet successfully whatever may lie ahead.

Amid all of the present-day confusions and conflicting ideologies, one thing stands out as a constructive force which offers real hope for the future to those who are concerned with the development of a better life. That constructive force is scientific management.

WHAT IS SCIENTIFIC MANAGEMENT?

Before we can understand how scientific management can help in world recovery, we must understand what it is. Scientific management is both a philosophy and a group of techniques, and its complete definition is difficult. It is something which started as an inspired idea and which has acquired meaning over the years without formal definition.

Some time ago, Dan M. Braum of the United States Department of Agriculture decided that he needed a definition of scientific management in connection with the training work that he was doing. He turned to Dr. Harlow Person and later to Dr. Morris Cooke for assistance, and with the aid of these two pioneers in the scientific-management movement, arrived at the following definition:

Scientific management exists primarily as a concept and mental attitude toward accomplishment. It exercises a basic systematic technique for discovering and establishing objectives, plans, standards, methods, schedules, and controls of an enterprise, all within the laws of each situation and in an environment of high morale; therefore it exemplifies the best use of human and material energy.

The implications of this definition are significant. The only place where scientific management exists is in the heads of the men who use it, and it can only be described in terms of the results of this thought process. Yet there is a basic flexibility to scientific management which is also implied by this definition. It is not necessary to have any particular set of ideologies for it to flourish. It is not even necessary to have any limited type of objective. True, we commonly think of scientific management in connection with greater productivity, and this it will yield under any given set of conditions. But if our goals become of a more spiritual nature—as, for example, greater human satisfactions from life itself as some advanced thinkers abroad are beginning to suggest—scientific management can accomplish this too.

Scientific management is a constructive force which seeks to reach its goals, whatever they are, within the natural laws of the situation. It avoids stubborn butting against stone walls. It requires no rigid adherence to set doctrine or specific ideology. Doctrines and ideologies may change, but the scientific-management approach is unchanging, because it operates on the basis of conformance to the laws of the situation, whatever they are.

WORLD RECOVERY DEPENDS UPON PRODUCTION

At the present moment, the major requirement for world recovery is production. Particularly in the war-devastated countries, people need desperately the production of material things if they are to enjoy even a passable standard of living. Europe especially is sick, and although progress toward recovery is being made, there is still a long way to go.

A few months ago the United Nations Department of Economic Affairs, through the Research and Planning Division of its Economic Commission for Europe, completed an exhaustive study of the European situation and issued a highly informative report under the title of "A Survey of the Economic Situation and Prospects of Europe." Under the head of "Problems of European Recovery," the report states that the restoration of equilibrium in Europe's balance of payments with non-European countries will require a concentrated effort over a period of years. Success will require: (1) the cure of Europe's present monetary instability, (2) the restoration of intra-European trade to prewar levels, and (3) the further expansion of production along the lines necessary to meet the needs of intra-European trade and overseas exports.

I would like to focus the spotlight on that last condition, the expansion of production. The report, under the head of "The Problem of Production," after pointing out that supplies of basic materials are improving, goes on to say:

There is also the problem of man power; with man-power reserves practically exhausted in most European countries, further increases in production must in the main come from increased production per man-hour. The productivity of labor has been increasing from the very low levels which prevailed in many countries at the end of the war, but in so far as can be ascertained, taking Europe as a whole, it is still considerably below the prewar level. With the progress of modernization plans and further improvements in stocks of materials, the productivity of labor is likely to increase further, although clearly progress in this direction will tend to slow down once the prewar levels are attained or exceeded.

That last statement is worthy of further examination. It appears to set as a goal the restoration of productivity to near prewar levels and then to assume that increases in productivity thereafter will be relatively small. This is a natural conclusion for economists to reach perhaps, but it overlooks the really great potentials for increasing productivity which exist in Europe today.

Europe must be much more productive than it ever was before the war if it is to enjoy the modern standard of living and all that this implies, which this country has demonstrated can be achieved. This is not a European problem alone but is a matter of concern for every one of us here in America. As long as

Towne Lecture presented at a luncheon meeting of the Management Division in conjunction with the Annual Meeting, New York, N. Y., December 1, 1948, of The American Society of Mechanical Engineers.

large groups of people in Europe are forced to exist at the subsistence level, so that they have no particular stake in the established economy of their countries, then we can expect unrest, a willingness to go off on unsound economic tangents, and even a mental readiness for war. Until the "have not" people, and the "have not" nations join the ranks of the "have" people and nations, we can expect continuing threats to the peace of the world.

AMERICAN PRODUCTIVITY CAN BE INCREASED

Is it possible for the "have not's" to become "have's"? They can if productivity can be increased. And can productivity be increased? Of course it can. Even here in the United States of America where we talk proudly about the "miracle of production" we accomplished during the war, we are improving our methods and increasing our productivity constantly. Even in productive America, we have yet realized only a fraction of the benefits which scientific management can bring. If, for example, every factory in our country could be managed as well during the next month as the best plant is now managed, we would see an expansion of production which would make the accomplishments of the past seem small indeed by comparison.

There are so many ways in which production increases can be obtained that progress can be unending under proper management. New machinery for the further mechanization of industry may be difficult for Europe to finance at the moment, and the newer kinds of raw materials may be unavailable. But experience in this country has shown that production increases of 20, 50, 100 per cent, or more can be obtained by improving methods in ways which require for the most part only the systematic application of common sense. Greater yields of first-quality products from a given quantity of material can be obtained from the introduction of quality control. Production increases to an extent that we ourselves scarcely realize as yet can be obtained by the better handling of human and group relations and the improvement of industrial leadership methods.

These techniques and others will be just as valuable in other countries as they have been here. Most of us who have visited Europe recently and have observed European industry at close range are convinced that the European worker can be just as productive as his American counterpart under the proper conditions. All that is necessary is management, sound scientific management of the type described by our definition.

In Europe, the scientific-management movement is really only just now beginning to get under way. True there have been advocates of scientific management and societies devoted to the study and application of scientific management in Europe for many years. However, it required the destructions of war to bring home the fact that production is the only real basis for material prosperity. With this realization came a real enthusiasm for scientific management which promises the greater production which is so badly needed. A steadily increasing stream of publications dealing with scientific-management procedures and techniques is beginning to reach us from overseas, tangible evidence of the new vitality of the movement abroad. CIOS, the International Committee for Scientific Management, strongly supported by American management groups including our own ASME, is steadily gaining strength and stature and is becoming a constructive force in the economic and industrial life of all of its member nations, both inside and outside of Europe.

PORTFOLIO OF WORLD MANAGEMENT PROBLEMS

And this is as it should be for more production is not a European problem alone but is a requirement of the rest of the world too. This was clearly demonstrated about three weeks ago when the National Management Council of the United States of America issued to its members a semiconfidential portfolio of top-management International Exchange letters. These letters were written at the request of CIOS by top-management men in different countries, and they commented on the major management problems they face in their countries at the present time. It was most interesting to discover that in practically every letter from every country there was one problem which was repeatedly stressed—the shortage of labor. Everywhere the demand for production exceeds the ability to produce, with lack of man power a major factor. This is even more significant when it is noted that nearly every letter pointed out that production already greatly exceeds prewar levels.

There is a world-wide labor shortage and all inquiries into the reasons for it yield a simple explanation. The answer given is, in effect, "Our people are no longer content with the standard of living they accepted before the war. They want more of everything and our production facilities cannot keep pace."

With this trend developing in nearly every country in the world, including our own, it appears—if we can avoid the major upheaval of another war—that we are in for the greatest industrial expansion that the world has ever seen. People want more things. The old fears of technological unemployment are disappearing as the result of the assurance given by better social programs throughout the world and the growing acceptance of the fact that to have we must produce. Scientific management faces a real challenge, a challenge which it is ready and only too glad to accept. Scientific management can and will lead the way to the production of more and more goods.

CAN WE STAND PROSPERITY?

But human nature is a peculiar thing. Can we stand prosperity? Will we be able to settle down and enjoy the fruits of our productivity? Will we be content with a high standard of peaceful living? Or will we use our increased productive capacity for the faster production of the means of destroying ourselves?

I do not suppose anyone really knows. Some feel that with security and material prosperity will come the universal desire for peace. Others predict that in addition a great religious revival will be necessary to cause us to cease our warring.

The answer is not yet clear, but I would like to point out that scientific management has within itself the seeds of peace. Scientific management never uses force to accomplish its objectives. It seeks first to understand the laws of the situation. Then it eliminates the obstacles to accomplishment and provides incentives which will cause people to wish to do what is best for the good of the enterprise.

SCIENTIFIC MANAGEMENT IN GOVERNMENT!

There is little of this approach in government today, anywhere in the world. I submit that the world today is in the state that it is in because of a lack of application of the principles of sound management to national and international affairs. Countries are managed by their governments, to be sure, but it is still a matter of the management of an enterprise—which in this case is life itself—by a group of human beings. In view of the conditions in which we find ourselves, it is evident that there has been a sad lack of management.

Scientific management recognizes the value of incentives. Then why not incentives for peace, properly defined, established, publicized, and sold? If the scientific approach can be

carried over into government, then at last there is hope for the future.

Already there are signs that this is taking place. If we look back on the industrial pattern, we find that scientific management did not start usually at the top of the organization. Technicians who believe in scientific management, like the industrial engineers, were given a chance to show what they could do by progressive top managements, and they were the ones who really carried the banner of scientific management forward. With surges ahead alternating with discouraging setbacks, they gradually demonstrated the value of the scientific approach, particularly on manufacturing problems, until its worth began to be recognized, accepted, and adopted by other areas of the business.

So it may be in government. Scientific management is now beginning to get into the more technical levels of government. The Society for the Advancement of Management, for example, has a government-relations division which is encouraging the application of scientific management to government activities. The Army and Navy have finally dropped their 36-year-old restrictions against the use of time study. The same sort of thing is beginning to happen within government circles in other countries.

It is a hopeful development, for from this modest beginning the scientific approach is bound to spread upward through the years and eventually will affect the higher levels. Cold scientific reason will probably never prevail entirely in the management of human affairs, but the scientific approach can recognize the emotional factors which exist within any situation and perhaps can learn to control them within limits.

CHALLENGE TO SCIENTIFIC MANAGEMENT

This then is a challenge for scientific management. Is it too much to expect that if we in industry demonstrate constantly the value of the scientific-management method, the day eventually will come when the managers of countries will follow our example and will eliminate the obstacle of war and provide the incentives which will result in lasting world peace? Here indeed is a cause which deserves the support of every responsible management man who wishes to see his children and his neighbors' children grow up in a better world. Scientific management can be a vital factor in world affairs. Let us all resolve to give it our utmost support whenever and wherever we can.

If we do this with sincerity, then these United States need not be "The last best hope on earth," but rather, a new hope—a new hope for maturity in governmental and international affairs—a new hope for a better future everywhere in the world.

Rockets as Research Tools in Aeronautics

(*Continued on page 204*)

radiations of the sun. Communication engineers know the interruption to the transmission of speech and code messages when the upper atmosphere is disturbed. The commercial value of uninterrupted communication added to the curiosity of scientists led to intensive study of the upper atmosphere by many indirect means.

Rockets in the course of their military uses have actually propelled vehicles to high altitudes, and the knowledge and experience gained in their development make possible the design of special sounding rockets for the direct study of physical phenomena at high altitudes. A new incentive for such study has also arisen. The air-breathing forms of jet propulsion consume fuel at a much smaller rate than the rocket, since the oxygen then comes from the atmospheric air. Therefore, air-breathing engines should be used wherever possible. Economic travel at supersonic speeds will be possible only at high altitudes. However, the difficulty of keeping the fire burning in an air-breathing jet-propulsion engine increases as the altitude of operation is increased. To study these problems, as well as the lift, drag, and stability of vehicles, we need to know the physical conditions so that they can be reproduced on the ground in laboratory research equipment.

One of the principal uses of the captured V-2 rockets which are being fired by the Army Ordnance Department at White Sands is this type of study. A great many agencies have cooperated in the work. Special sounding rockets have now been developed and the work will proceed at a greater rate. The NACA is engaged in the problem of reproducing the physical conditions of interest for studies of aerodynamic and combustion phenomena. One of its many advisory subcommittees serves as a meeting place for exchange of scientific data on problems of the upper atmosphere.

I will leave to others the prophecy of the future uses of rockets. What I have outlined is what rockets are now doing to advance aeronautics.

Air Transportation

ACCORDING to the Air Transport Association of America, the scheduled airlines of the United States completed the year 1948 with one of the best all-around safety records in the history of commercial aviation.

The domestic scheduled airline record for the year was 1.41 passenger fatalities for each 100,000,000 passenger-miles flown (equal to approximately 4000 trips around the earth at the equator). This compares with 3.2 passenger fatalities for each 100,000,000 passenger-miles flown in 1947.

These figures are based on data furnished by the research department of the Air Transport Association of America.

During 1948 there were four accidents on the domestic airline routes involving 83 passenger fatalities, while in 1947 there were five accidents involving 199 passenger fatalities.

The U. S. flag carriers operating internationally completed the year with a record of one accident on scheduled flights, involving 20 fatalities. This gives the U. S. overseas operators a record of 1.06 fatalities per 100,000,000 passenger miles, as compared with 1.08 for 1947.

Much of the credit for the improving safety records for U. S. airlines, according to an ATA spokesman, can be given to the concentrated program carried on by the airlines and government agencies throughout 1948 for the purpose of improving safety and dependability. This program, which will continue for several years, includes the installation and operation of the Instrument Landing and Ground Control Approach Systems; traffic segregation in congested areas; improved radio communications; high-intensity approach lighting system; a 50 per cent reduction in ground delays; tremendous reduction in maintenance delays; and other navigational and traffic improvements.

The safety record is said to be more remarkable because during 1948 many airlines inaugurated new types of equipment which required the retiming of schedules and revision of many departure and arrival patterns. Additional installation of new navigational equipment in the airplanes and on the ground is contemplated.

DOES WESTERN EUROPE HAVE A FUTURE?[1]

By CHARLES P. KINDLEBERGER

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GOOD economics and good journalism seldom occur in the same person in the United States. While the combination is not as rare in Britain, where the art of being articulate is more assiduously cultivated, it seldom is found in an attractive young lady. When such a person writes about a subject as important as the economic future of Western Europe, the result is practically irresistible.

Barbara Ward's book[2] has been widely hailed by the critics. It is called "informed, intelligent, lucid, enlightening, provocative." Miss Ward herself is invariably referred to as brilliant. There is no reason to dispute the latter contention. Miss Ward has given full proof of her impressive capacities as an editor (of the authoritative *Economist*), director (of the BBC), pundit (of the British version of "Information Please"), speaker, and writer—all this at the tender age of 34. Unhappily it is necessary to disagree with the general verdict on the book. It is disarmingly lucid and persuasive. But the general reader should be wary about following Miss Ward beyond a certain point.

"The West at Bay" is divided into four parts. The first is devoted to a demonstration that the nineteenth-century world predominance of Europe is dead beyond recall. The second establishes that American participation in world affairs is likely to be more positive, continuous, and disinterested than in the past. The third section is almost purely descriptive, rather than analytical, and covers the origin and development of the European Recovery Program—more usually known here and abroad as the Marshall plan. In the fourth and final part of the book, Barbara Ward attempts to demonstrate that the plight of Europe calls for unorthodox measures to insure European survival. In particular she believes that the times are so out of joint that Western Association is imperative—a close political federation (or union?) with provision for joint military defense and a complex set of economic arrangements. These economic plans, to which Miss Ward devotes a third of the book, fall under four broad headings: First, the allocation of scarce raw materials by international governmental combines in coal, steel, iron, and foodstuffs; second, the planning of capital expenditures by the first three of these combines and by similar bodies in electric power, oil, and transportation; third, the gradual reduction of trade barriers within Europe until finally a customs and currency union results; and fourth, a concerted attack on the European balance-of-payments deficit with the dollar area, including co-operative efforts to find in outlying regions new production purchasable in other currencies to replace imports from this country.

Miss Ward is on solid ground when it comes to diagnosis and description. Western Europe, like the old gray mare, "ain't what she used to be." Parts of Western Europe—Greece, Spain, Portugal, never were, or at least haven't been for 2000, 500, and 300 years, respectively. Two wars in twenty-five years have exacted their toll. The attempt made to recover from the first of these, moreover, corrected symptoms rather than the disease. Equipment was patched up, markets were apportioned, profits were maintained through holding up prices. The opportunity was lost to modernize equipment, reduce costs, increase productivity.

The ills of Western Europe, however, stem from deeper causes than mere wars. Europe is paying the penalty for having gotten such a large headstart in industry that it lost the interest and capacity to keep up with its competitors. The analysis applies more closely to Britain and France than to Germany or Sweden, perhaps, but it has a degree of general applicability. Western Europe got there first with the industrial revolution, but with notable exceptions lost out on the chemical, electrical, automotive, mass-production, and mass-precision revolutions. As a consequence, what of Europe's equipment at the end of the war was not destroyed or undermaintained was obsolete. Industrial supremacy was lost to the United States.

The war and the social ferment associated with it produced two further changes of moment for Europe. Prospects for large profits from Southeast Asia are dimmed probably for all time. And the exchange of manufactures from Western Europe for foodstuffs and raw materials from Eastern Europe will proceed, if at all, on an entirely new basis.

These broad influences affect the countries of Western Europe, to be sure, in unequal degree. Some of these countries, however, have different troubles—as in the case of defeated Western Germany. All of Western Europe, however, is affected by the illness of its important parts. In economics, Western Europe must hang together.

The passages on the development of American foreign policy to be anticipated for Western Europe deal with material which is familiar. Their conclusions are at the same time reasonable and comforting. Miss Ward doubts that the United States will return to isolationism. She worries more as to our ability to avoid depression, but suspects that we are going to try, no matter what the political complexion. Finally, she succeeds in demonstrating, to the probable satisfaction of all but dyed-in-the-wool Marxists, that the United States is not likely to pursue the course of a rapacious imperialist.

The third part of the book, describing the development of the Marshall plan, both in the United States and in Europe, is straightforward and reasonably accurate.

So much for description. Thus far Miss Ward has done a useful job of analysis and exposition, for the most part in well-paced prose.

When it comes to the goals of European recovery, Miss Ward's views are acceptable enough, though confusion and vagueness occasionally creep in. This is the case, for example, when she talks of restoring the 19th century balance between Europe and the rest of the world, for this is certainly gone forever, or when she suggests that the object is to build the foundations for a partnership of equals between the United States and

[1] One of a series of reviews of current economic literature affecting Engineering prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "The West at Bay," by Barbara Ward, W. W. Norton Company, Inc., New York, N. Y., 1948.

Europe. The aim of the program is broadly to maintain liberal democratic political institutions in Western Europe, through shoring up the economic basis of those institutions. In narrower economic terms, ERP is designed to put Europe into position to pay its own way at tolerable standards of living. Paying its own way means, particularly, exporting enough to pay for imports, and within the totals, to obtain enough dollars for exports to pay for imports in dollars.

When dealing with means to these ends, however, "The West at Bay" gets into difficulties. What is meant by Western Association, and in particular by economic Western Association? Miss Ward's answers are unsatisfactory.

Miss Ward plugs hard for "integration, co-ordination, co-operation." The awkwardness is that these words, no matter how polysyllabic and mouthfilling, have no meaning by themselves. And when it comes to her concrete program for combines, planning of capital development, removal of trade barriers, and discrimination against imports from the dollar area, her program fails to add up.

Take the raw-material combines for example. Miss Ward expects these to start as committees allocating raw materials in short supply, to develop into federations of nationalized industries, and to emerge as Western European "internationalized" combines. It is true that international co-operation in the allocation of raw materials is useful as a recovery measure. This work is now going forward at several levels—in the International Emergency Food Council (IEFC) of the Food and Agriculture Organization of the United Nations; in the Economic Commission for Europe (ECE), a regional Commission of the United Nations; and in the Organization for European Economic Cooperation (OEEC), set up to operate the European end of the Marshall plan. International allocations of wheat, fertilizer, coal in general, coking coal, timber, steel, etc., take place to a limited degree, affecting the exportable surpluses of certain countries. But these industries are not nationalized in all countries of Europe—and are not likely to be in all of them. And the role to be played by the same national industry in many of the countries of Europe differs markedly.

After the period of shortage was passed, how would the international combines operate? Miss Ward is especially vague on this point. They might assist in meeting the dollar problem by planning investment in lines which will expand exports and limit imports from the dollar area. They might go on to narrow differences in wages and standards of living between various countries in the same industry—though not eliminating them, and to mitigate business-cycle fluctuations in Western Europe through anticyclical investment policy.

This line of reasoning verges on sheer nonsense. International planning in war and immediate postwar involves the task of allocating scarce resources among what appear to be practically unlimited ends. As such it is relatively simple. The analogies which Miss Ward cites of her combines to the Anglo-American Combined Boards and the Middle East Supply Center during the war are not applicable to the period after the acute shortages have passed.

In periods of peace, planning on a national scale involves the selection of one or more criteria on which to operate. The object may be to economize scarce materials. It may, on the other hand, relate to the maximization of such values as output, employment, wages, the minimization of cost and investment, or some other entirely different measuring rod such as narrowing regional wage differences. Unless there is a simple set of criteria, the task even for national planners is hopeless. On an international scale it would be bedlam.

Miss Ward recognizes this in quite a different connection. In her "Limits of Economic Planning" in the January, 1949, *Foreign Affairs*, she suggests with great persuasiveness that the government should limit its intervention in planning to maintaining employment (and competition), and that if this be done, private industrial planning can go forward on the simple basis of attempting to maximize profit.

In "The West at Bay," however, no criteria are developed. Miss Ward's combines will either blow up, should they go so far as to get started, or they will settle down to operate on one or two elementary principles, the most likely of which are to stifle competition and to divide markets. Miss Ward cites the international steel cartel as an example of international planning. She is obviously uncomfortable with the example and insists that what she is after is planning comparable to that of the cartel but in the national interest of all participants and in their joint interest. There is no suggestion as to how this change of beneficiary can be brought about.

Similar vagueness attaches to Miss Ward's notions about planned capital investment in oil, power, and transport. Should these maximize dollar receipts, minimize dollar expenditure, maximize social utility, and stabilize employment and investment at the same time? And what need is there for customs and currency union if the economic processes of her new Europe are to be carried on exclusively by planning?

"The West at Bay" not only falls down in indulging essentially romantic notions about "integration;" it fails to give adequate attention to the relations between productivity, the standard of living, and viability in international economic relations. With relatively full employment Europe cannot expand production except by making goods cheaper in terms of man-hours. Unless productivity can be increased, exports cannot be increased nor can imports be reduced, except by taking the necessary goods out of the standard of living. Integration does not lead invariably to an increase in productivity. In some fields this requires the elimination of social dislocations such as absenteeism. In most it requires new investment, the elimination of obsolescence and willingness to employ new methods of production, in their own interest, by farmers, labor, and capital. This vital subject is almost entirely ignored.

As an analysis of Europe's economic ills and a plea for their solution, "The West at Bay" is readable, and indeed frequently eloquent. As a blueprint to assure Europe a future, it falls short of the standards it sets for itself.

Patents and the Courts

(*Continued from page 228*)

Department of Justice under various administrations to effect changes in the statutory law which the Supreme Court has put into effect by judicial pronouncement, the consistent refusal of Congress to adopt such restrictive laws would seem to indicate that there is only one clarifying remedy, namely, the enactment by Congress of final determinative legislation to clear up the question of whether the Supreme Court of the United States is acting within Congressional intention under the present statutes or whether it has erred and must be corrected under our system of checks and balances by new legislation of Congress restoring to the patentees the rights taken from them by the Supreme Court and other courts, after having been granted to them by Congress for more than a century of our history.

It would seem that the prosperity based upon this century of interpretation should not be lightly cast aside by judicial pronouncement. If the elected representatives of the people wish this to be the way of our life, then so be it; but the engineering profession and the manufacturing interests of this country (so largely based upon invention) should at least have their "day in court" before Congressional committees and a review of the situation by Congress in view of the importance of the issue.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Atomic Energy Report

THE Fifth Semiannual Report of the Atomic Energy Commission was released recently and it indicates that expansion and improvement were made all along the atomic-energy development chain, from the mines to the ultimate use made of fissionable material.

During its first two years of operation, the AEC carried on two full-scale operations simultaneously—maintaining and increasing output of fissionable materials and modernizing facilities and increasing production capacity for the future. Improved operating techniques and equipment already have gone into operation. At many stages of production knowledge gained could be put to work only by building major additions to existing plants or entirely new units that could make use of new methods or materials discovered.

More than 15,000 construction workers are employed on the new reactors and on supporting facilities for research, transportation, storage, housing, and community needs. Important units are scheduled for completion during 1949.

The activity of the AEC receiving major attention in the area of military applications has continued to be the production and improvement of atomic weapons. This includes the production of fissionable material, the manufacture of weapon components, and the development of new designs of weapons. Important advances were made in all of these fields in 1948. New designs of weapons have been tested and found to be successful, and further developments are now in progress. Work has also been done on the engineering development of weapons for greater ease of production and greater serviceability.

During 1948 the Commission strengthened the organization through which it co-ordinates a nation-wide research effort, both in its own and in contractors' laboratories.

According to the report, the Commission and the Office of Naval Research agreed upon a program of joint support of fundamental research in which the two agencies have a common interest. A total of 45 contracts in physical research were selected for support in whole or in part by the Commission. These projects cover a wide range of investigations in nuclear and general physics, chemistry, metallurgy, ceramics, mathematics, and geophysics.

A major part of the Commission's physical research funds in 1948 was used to support work in physics, particularly nuclear physics, the design and construction of particle accelerators, design of research reactors, design and construction of radiation detection instruments, and the improvement of isotope separation methods by means of the mass spectroscope.

The most extensive field of data accumulation comprises the studies of what happens when the fundamental particles of the atom collide with one another or with the nuclei of varying forms or isotopes of the atoms of the 96 elements so far identified.

The AEC also carries on a biological and medical research program in its own laboratories, lets contracts with a large number of other governmental and private institutions for biological and medical research work, and provides radioactive research materials and information to private laboratories engaged in research programs of their own.

One of the five major programs which the Atomic Energy Act of 1946 directs the Commission to carry on is "a program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress."

Starting in 1947 the Commission has taken steps to clarify policies and guide information operations including the following:

1 Designation of unclassified fields of research related to atomic energy. These fields are generally free of any security regulation.

2 Over-all revision of the Declassification Guide originated by the Manhattan Engineer District. These revisions were made jointly with the United Kingdom and Canada. Joined with the United States in the wartime atomic-energy program, these countries are following identical declassification policies with respect to information jointly held.

3 Adoption, with the National Military Establishment, of a joint classification guide for the military application of atomic energy, with special provision for the handling of data primarily of military operational nature.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources, i.e.: (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

4 Action to develop more precise and more flexible methods of determining what information must be withheld from general publication and what may be publicly issued.

Three interdependent programs operate to safeguard restricted data and to protect installations in the atomic-energy program. They are as follows:

1 Personnel security—to determine the eligibility for security clearance of employees of the Commission and contractors who have access to restricted data.
2 Physical security—to guard installations, materials, and information, and prevent sabotage, espionage, and theft.
3 Document and information control—to systematize and enforce procedures to withhold classified information from unauthorized persons.

The Commission has several hundred contractors carrying on its operations. These are private industrial firms, educational, and scientific institutions. Since this program is essentially an industrial undertaking, modern accounting and auditing methods used in industry and commerce are being installed at AEC facilities. The General Accounting Office has approved installation of these methods.

Five public accounting firms have reviewed and evaluated accounting practices under typical contracts which the Commission took over from the Manhattan District covering town management, research, plant construction, and production. The usual government record-keeping and audit procedures used before, it was found, did not provide up-to-date records of costs and controls of property.

In 1948 the Commission gave certain Division Directors responsibility under the General Manager for the major programs of the Commission—research, production, engineering, military application, biology and medicine, and reactor development. Principally because of demands on the General Manager's time by agencies outside of the Commission a Deputy General Manager was appointed to give full time to daily operating problems. At the same time the reorganization preserved the primary responsibility of the five operating managers for major phases of the program. These managers are located at Los Alamos, N. Mex.; Hanford, Wash.; Chicago, Ill.; Oak Ridge, Tenn.; and New York, N. Y. This step reduced from 19 to 12 the number of persons reporting to the General Manager.

In keeping with the controls which the Congress established over fissionable materials and atomic weapons, the Atomic Energy Act includes special provisions relating to patents and inventions in the field of atomic energy. In brief, the act specifies that patents shall not be issued for any invention "useful solely in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon." The act also states that patents shall not confer any rights to the extent that the invention "is used" for such purposes. Just compensation is assured to owners of any already existing patent rights revoked by the act; and in so far as these provisions prevent future inventions from coming within the regular patent system the AEC is empowered to make awards after hearings held before its Patent Compensation Board.

Air Force Research

CONTINUING the U. S. Air Force's research program, the Air Force's Bell X-1 has taken off under its own power for the first time, attaining an altitude of 23,000 ft in 1 min 40 sec after engine start. The flight was made at Muroc Air Force Base, Muroc, Calif., recently.

The X-1, originally designed for conventional take-off, was not modified for the take-off nor was any type of auxiliary power source used. The airplane climbed at air speeds up to 380 mph and remained aloft for about 8 min. The powered portion of the flight was less than two minutes. It was the first time the research airplane had taken off from the ground. Heretofore the X-1 has been carried to altitudes above 20,000 ft by a Boeing B-29 Superfortress and then released for independent flight in order to take full advantage of the limited fuel capacity of the airplane.

The airplane averaged a rate of climb of more than 13,000 fpm. Although this rate of climb exceeds previous records, no official claim will be made for this flight.

All four rocket motors were used during take-off which required a run of 2300 ft.

A piloted flying research laboratory with an extremely sturdy airframe, the X-1 has flown "hundreds of miles" faster than the speed of sound many times. It is a part of the co-operative Air Force-Navy-National Advisory Committee for Aeronautics effort to explore the problems of flight at subsonic, transonic, and supersonic speeds.

High-Speed Flight

FURTHER increase in airplane speeds depends upon developments which hinge on the human element, Dr. John T. Rettaliata, Mem. ASME, dean of engineering at Illinois Institute of Technology, Chicago, Ill., said to members of the Chicago section of the Institute of Aeronautical Sciences recently.

He pointed out that technical progress in designing airplanes which exceed the speed of sound has been so rapid in the past two years that the problem also now becomes one of concentrating on human problems.

Dr. Rettaliata warned that unless the pilot can survive and remain operative in the airplane, further technical advances are impossible.

He outlined the following four areas in biotechnology in which engineering and medical scientists are co-operating to push aircraft flight further beyond the speed of sound:

1 *Excessive heat in the cockpit.* Without cooling, the temperature at 670 mph (the official world's speed record) would approximate 200 F.

In an attempt to approach 'living room' conditions of temperature and pressure, scientists have developed a 16-lb unit which blows cold air on the pilot to keep him cool.

The unit contains a small turbine with a rotor $^1/_2$ in. in diam and weighing $^1/_2$ oz. It turns at 100,000 rpm.

2 *Blacking out.* To study pilot blackouts, some laboratories have set up intricate centrifuge equipment utilizing the principle of the farm cream separator.

No difficulty is encountered in the functioning of the mental processes when the speed remains constant, even though it may be as high as 1500 mph. However, rapid acceleration or deceleration (slowing down) may cause blackouts, he said.

The problem is to protect the pilot, such as by inflated clothing, in such a way that he will not blackout from blood leaving the brain in a pull-out from a dive, or from excessive blood being forced into the brain (called a "red-out") on an outside loop.

3 *Escape.* Speeds are now so great that pilots cannot climb out and slowly descend in a parachute. At high speeds, the tail structure would tear the pilot apart, Dr. Rettaliata said. (In airplanes with jet engines in the wing, the tails are built high to get them out of the way of passing blasts of hot air.)

German experiments during the war revealed that bail-outs

were disastrous to pilots. At speeds of 500 mph, the corners of their eyes and mouths were torn and their ears were literally ripped off the sides of their heads, he stated.

To solve the escape problem, designers have built ejector seats in airplanes and pilots have been equipped with canopies to protect their heads.

Human beings can withstand 25 times the pull of gravity on their bodies for $^1/_{10}$ sec, and that is long enough to get them out of the airplane, Dr. Rettaliata related.

4 *Crash trouble.* In crashes, pilots may be subjected to forces of 40 to 50 times the pull of gravity. Cockpits are being designed in an attempt to lessen this danger.

Scientific tests of the human body, mainly the bones, are necessary to determine what the pilot can withstand and what kind of equipment must be designed to protect him.

Human bones can withstand a compressive stress of 23,000 psi. That means they are one fourth as strong as cast iron and twice as strong as hickory wood. It means people are tougher than we ordinarily think. (See "Human Bone Properties," MECHANICAL ENGINEERING, October, 1948, pp. 827–829.)

Technical limitations on the speed of aircraft have not been reached. Future airplanes may well travel several thousand miles an hour, but the pilot must be able to withstand the physical stress which such speeds will bring.

Dr. Rettaliata indicated that the bottleneck in high-speed flight may be the human being unless science finds ways to protect him from the forces created by the higher speeds.

Jet Engine Self-Starter

ACCORDING to the CADO *Technical Data Digest*, January 15, 1949, the AiResearch Manufacturing Company, Los Angeles, Calif., and the U. S. Navy Bureau of Aeronautics have developed the first successful self-starter for jet and turboprop aircraft engines. The device eliminates the use of cumbersome storage batteries or other heavy auxiliary power units outside the aircraft and uses a small gas-turbine engine, weighing 88 lb, as its major component.

Highly compressed air is bled from this turbine to operate a high-speed air-turbine-starter unit, which is fastened directly to the jet or turboprop engine. With the self-starter, jet and turboprop planes will be able to make use of remote bases which are not equipped to start engines. The starter requires only a $^3/_4$-hp motor and a storage battery for its own starting.

The same turbine engine which powers the starter also can be

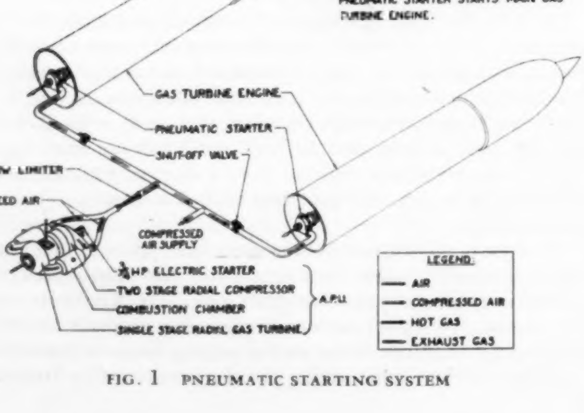


FIG. 1 PNEUMATIC STARTING SYSTEM

used for cabin pressurization, air-conditioning, heating, deicing, and other power-using devices.

AiResearch has built two versions of the gas turbine and each represents a substantial decrease in weight and size over present auxiliary units for aircraft. Both versions may be adapted for ground sources of auxiliary power and industrial applications.

The exceptionally high ratio of power for weight and size is made possible by a combination of high-precision turbine wheels spinning at more than 40,000 rpm and combustion temperatures of more than 1600 F.

The 88-lb turbine produces 65 equivalent air horsepower at sea level and the other, a 95-lb shaft power unit, develops 85 hp. With reduction gearing, both can be used to drive all electrical equipment and other power-using accessories.

AiResearch engineers believe these are the first radial inward flow power turbines ever to be developed. They involve a turbine principle designed to provide more power for weight and size than ever was realized from other power plants. Radial inward flow turbines have been used in the past with water and steam but this marks the first time the air or gas type has proved successful.

Axial-air-flow engines inherently sustain some loss but the loss is partially eliminated by the radial inward flow which is "accelerated."

Nodular Cast Iron

A NEW type of cast iron—nodular graphite iron—is described in a special article from British Information Services, New York, N. Y. The article, written by J. G. Pearce, director of the British Cast Iron Research Association, reveals that the Association has studied the formation of graphite in cast iron and as a result has recently evolved a process which results in gray cast iron, as-cast, and without heat-treatment, having the graphite in the nodular or spherulitic form. This does not mean that the new material has all the properties of malleable cast iron, as there are certain limitations on the type of raw material which can be so treated, but the new material represents a marked advance over ordinary gray iron in its mechanical properties, and may be regarded as a new engineering material coming between ordinary gray iron and malleable cast iron.

The process, which is patented in Britain and in many industrial countries and yielding a product known as Nodulite, consists essentially of adding a small amount of cerium to a particular type of base iron. The first effect of the cerium is to remove the sulphur. When that is complete the cerium tends to drive the iron white. By an adjustment of the amount to be added in relation to the amount of metal to be treated, it is quite practicable to get gray iron stronger than is normally obtainable. The material to be treated must be fairly high in carbon, low in phosphorus, and low in sulphur, and these requirements are best met by a low-phosphorus pig iron. In ordinary foundry mixtures containing scrap of such material, it may be desirable to desulphurize, as cerium is a rather expensive material to use for this purpose. It is available commercially in the form of misch metal, about half of which is cerium; the other elements present in misch metal do not interfere with the process.

It will be evident that the process is best carried on in a foundry which is technically controlled and has access to a laboratory. With these advantages there is no reason why the new material should not be produced with ease. Mr. Pearce points out that the British Cast Iron Research Association has a good deal of information and experience on procedure, and any firm interested in producing the material should communi-

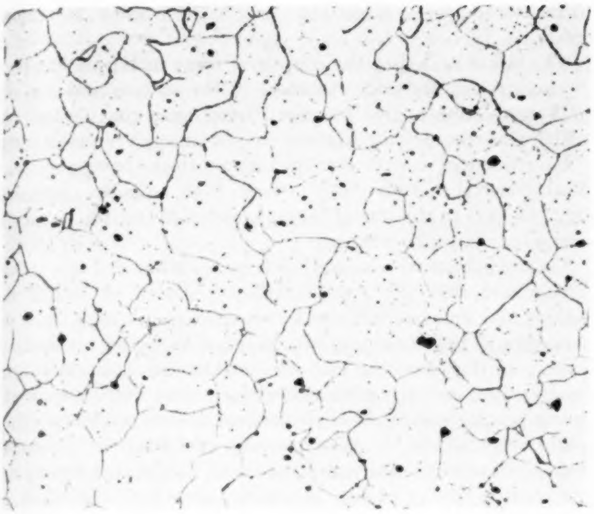


FIG. 2 GRAINS OF WROUGHT OR PURE IRON

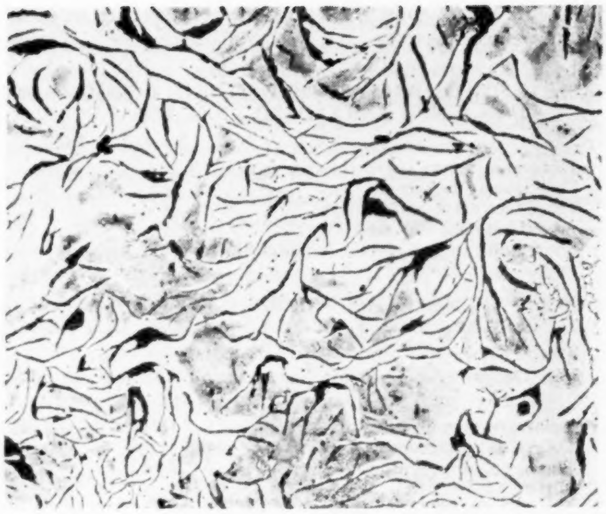


FIG. 4 UNTREATED PIG IRON

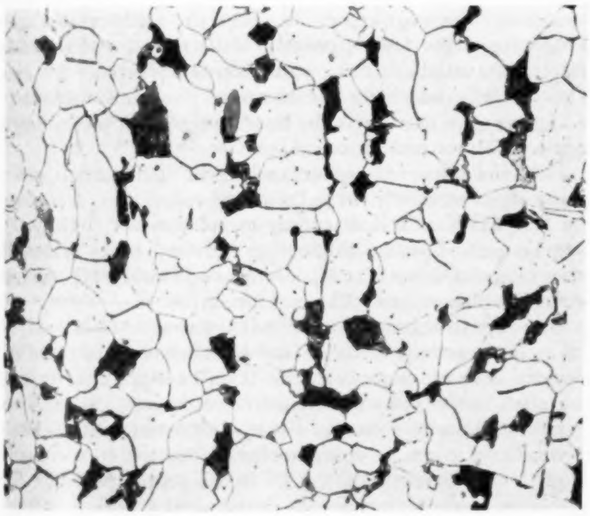


FIG. 3 GRAINS OF A MILD STEEL

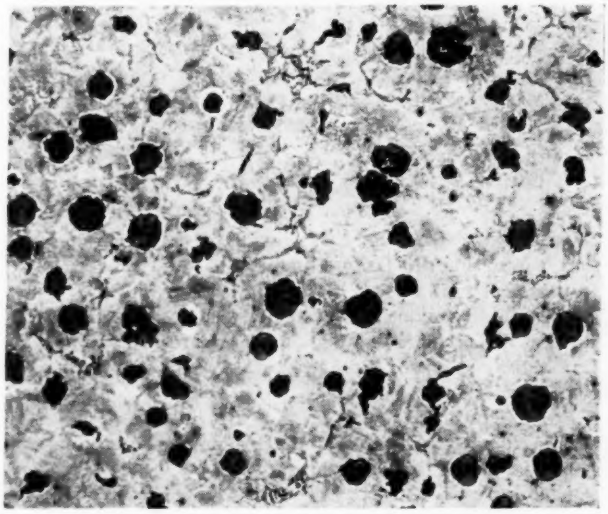


FIG. 5 NODULAR CAST IRON

cate with the Association at Alvechurch, Birmingham. The form of the process favored by the Association consists of the addition to the molten metal in the ladle of a predetermined amount of misch metal, followed by a ladle graphitizer such as ferrosilicon or silicon-manganese-zirconium. The process is not advised where the phosphorus content of the metal exceeds about 0.5 per cent.

Modern founders are aware that although ordinary common iron castings are usually in the ferritic or in the pearlitic condition, iron castings can be made to meet particular purposes with virtually metallurgical structure, for example, austenitic, martensitic, acicular. The nodular-graphite structure can be produced with any of these metallurgical structures in the metal and the use of alloying elements or heat-treatment to improve the strength of the metal structure by the usual procedures can be followed in the new material. In the ordinary unalloyed state the material is extremely soft and machinable on account of its rather high carbon content.

Fig. 2 shows the grains of wrought iron or pure iron, known as ferrite. Fig. 3 shows the grains of a mild steel, the small amount of carbon helping to form the pearlite constituting the darker grains. Fig. 4 shows a pig iron suited to the nodular process but untreated. The dark flakes of graphite can be readily seen. Fig. 5 shows similar material treated with misch metal, the flakes being replaced by nodules of spheroids of graphite.

The improvement in cast iron during the last quarter of a century has been accomplished mainly by improving the strength of the metal matrix, the graphite still taking the flake form, although the so-called ladle inoculation process of adding ferrosilicon, calcium silicide, or other ladle graphitizer, has done much to make this flake graphite regular and uniform. Ordinary phosphoric irons used in England for domestic castings and builders' ware may have a strength of 9 to 10 tons per square inch, while high-duty engineering cast irons may have strengths up to 25 tons per square inch on a standard test bar. In the recently developed acicular cast irons, alloyed with molybdenum and other elements, tensile strengths of 25 to 35 tons per square inch may be obtained. The soft and rather ductile austenitic irons may have tensile strengths of nine to 16 tons per square inch and may have elongations of one to four per cent.

The following figures give some idea of the properties of the cerium-treated irons:

TABLE 1 SIMPLE HEMATITE PIG IRON WITH A CERIUM ADDITION, USING A STANDARD 1.2-IN. TEST BAR

	Before	After
Transverse rupture stress, tons per sq in.	24.8	43.8
Deflection at fracture, in.	0.29	0.50
Tensile strength, tons per sq in.	13.0	21.4
Brinell hardness	163	185
Impact, lb	13	45

TABLE 2 HEMATITE PIG IRON, DOUBLE-TREATED, I.E., WITH CERIUM AND A LADLE GRAPHITIZER, USING 1.2-IN. STANDARD BAR

(One melt is plain and the other contains a little copper.)

	Melt A	Melt B
Transverse rupture stress, tons per sq in.	70.2	71.9
Deflection at fracture, in.	1.03	0.54
Elastic modulus, millions of lb per sq in.	23.4	22.8
Ultimate tensile stress, tons per sq in.	30.6	37.8
Brinell hardness	230	271
Impact strength, lb	57	64

TABLE 3 ANALYSES OF MELTS

	Melt A	Melt B
Total carbon	3.55	3.68
Silicon	3.01	2.34
Manganese	0.89	0.77
Sulphur	0.004	0.009
Phosphorus	0.044	0.035
Cerium	0.053	0.054
Copper	Nil	1.49

On standard 0.875-in. bars with a tensile strength of 35.2 tons per sq in. the fatigue strength in bending fatigue was 16 tons per sq in.

The simple treatment of austenitic cast iron (Ni-Resist of 12 per cent nickel and 6 per cent copper) resulted in an increase of transverse and tensile strengths and deflection of some 60 per cent.

From an ordinary foundry cupola using desulphurized metal, tensile strengths of 34 to 38 tons per sq in. were obtained on test bars from 0.6 in. to 3 in. diam.

Nodular cast irons may be dead-annealed, normalized, or heat-treated by quench-temper methods, Mr. Pearce states. Dead-annealing is accomplished very quickly and elongations up to eight per cent have been recorded on such material, and even higher figures for austenitic irons.

The range of properties indicated will enable those interested to see for themselves the uses to which nodular cast irons may be put. The limitations imposed at present by the material which can be treated means that for the time being the main outlet will be in engineering castings and many foundries in Britain have made castings for service trial in the engineering and automobile industries.

Building Construction

A FIVE to ten per cent decrease in the volume of construction from last year's all-time high, resulting in stabilization or even reduction of building costs, was forecast for 1949 by Melvin H. Baker, president, National Gypsum Company, Buffalo, N. Y.

Increased availability of labor and the tendency among contractors to use more modern methods, machines, and materials were cited by Mr. Baker, as factors which will cut into costs, in an address delivered at the 1949 Annual Meeting of the American Society of Civil Engineers in New York, N. Y., recently.

Mr. Baker said that the output of most materials has been increasing steadily since the close of the war, estimating the 1948 production at five per cent higher than that of 1947, in which was recorded the highest output of any year since 1915.

He attributed the 117 per cent increase in the composite price of all construction materials in June, 1948, over the composite price in 1939 to the record-breaking demand and the impact of postwar inflationary forces.

On the subject of relationship between labor and prices, Mr. Baker said that the apprenticeship program on which the unions and industry have so fortunately co-operated since the war should begin to pay off this year, bringing hundreds of young skilled workers into the building trades. Industrial leaders, despite their general optimism that high output will lower prices, warned about two influences that might turn their plans awry. First, it was repeatedly said that the determination to hold prices down in 1949 would be defeated by any material demand for higher wages by mine and mill workers. The second warning that industrial leaders have emphasized is that the outlook for increased availability of materials is clouded by uncertainty over the domestic and foreign political situation. We must expect that both the European Recovery Program and the defense program will cut into the supply of materials available to the construction industry. We must also carefully watch for the effects of possible Congressional action on such matters as the housing program, price control, and legal allocations, he stated.

New and improved products which he said are designed to bring about more efficient building and reduce costs were listed by Mr. Baker as follows: ready-mixed cements, lightweight aggregates, and prefinished flooring and availability in modular sizes of such materials as brick, tile, wood and metal sash, and doors, wallboard, and rock wool insulation.

As materials become more abundant during 1949, he said, the effect of these improvements and of others still to come will become more and more evident. It will become clear that the materials industry, by greatly increased capacity, by the diversion of millions of dollars to research for better quality and the lowering of costs, is doing a tremendous job to maintain a high level of construction. To house people properly, construction must continue for the next several years at levels even higher than the 18 billion dollar record for last year. Except for shortages of materials and labor required in the plants, mines, and forests, the materials end of construction is now ready to meet most any situation required.

Accelerometer Calibrators

THE increasing use of accelerometers for motion studies capable of recording accelerations applied in a few thousandths of a second, and with ranges as high as 500 times gravity in extreme cases, has necessitated the development of improved methods for their calibration. Advanced research testing of guided missiles, high-speed aircraft, airplane crash and landing-impact phenomena and seat-ejection devices has expanded the demand for accurately calibrated accelerometers in the higher ranges. Following recent investigations in this field for the Bureau of Aeronautics, Department of the Navy, scientists of the National Bureau of Standards have designed and constructed three types of calibrators which show remarkable correlation in their results even though based on different principles of operation. At the same time they effectively reduce the limitations encountered with other calibrators for accelerometers. With the new calibrators means are provided for subjecting light ac-

celerometers, up to one half pound in weight, to known accelerations over a wide range of acceleration and frequency.

Using the three types of calibrator devised—centrifugal, shake table, and portable pulse—accelerations for calibrating accelerometers are provided over the following ranges of acceleration and frequency:

Type calibrator	Frequency cps	Range g	Acceleration control
Centrifugal	0	0–1000	Continuously variable
Shake table	10–115	5–100	Continuously variable within limits
Portable pulse	30	0.8–19.5	Six steps

The first type affords an ideal means of subjecting accelerometers to a steady acceleration. The second type is very useful for subjecting accelerometers to sinusoidally varying accelerations of known frequency and amplitude. These two calibrators are primarily laboratory instruments. The third type provides a convenient and readily portable means of calibrating complete accelerometers and their associated equipment in the field.

In the centrifugal calibrator, a direct-current motor drives a horizontal table, in the form of an aluminum-alloy disk 22 in. in diam and 1/2 in. thick at speeds up to 2000 rpm. The instrument to be calibrated is bolted to the disk near its outer edge and the necessary electrical connections for reading the instrument are made to a set of binding posts mounted on the disk. Up to nine electrical connections can be brought out by means of copper-graphite brushes on copper slip rings. The weight of the instrument being calibrated is balanced by a similar weight placed diametrically opposite on the table. This, however, need not be a precision balancing operation because the whole calibrator is shock-mounted to have a horizontal natural frequency of about 5 cps, permitting the table to find its own center at practical calibrating speeds. The acceleration on the test instrument is calculated from the rotational speed of the table and the radius from the center of the table to the center of mass of the seismic element of the accelerometer.

When utilizing the shake-table calibrator, the accelerometer under test is attached to a carriage which carries an unbalanced wheel and is supported by parallel flexure plates from a heavy base. The unbalanced wheel is driven by a very light thread belt which is in turn driven by a direct-current electric motor equipped with speed control. In operation the unbalanced wheel is driven at a frequency well above the natural frequency of the suspended carriage so that the displacement will be more or less constant with varying frequency. The entire calibrator is shock-mounted to isolate it from building vibration while the driving motor, carefully selected to be vibration free, is entirely supported by sponge rubber.

In order to cover the full range of frequency it is necessary to employ several sets of flexure plates. Thicker plates are used at the higher frequencies to eliminate secondary resonant responses. The unbalance of the wheel, which controls the amplitude of the carriage, can be changed by varying the weight of the unbalance or by changing the vector sum of the forces produced by two weights placed in holes around the periphery of the wheel.

The maximum acceleration is computed from the rotational speed of the wheel and the displacement of the carriage. This displacement is measured with a reticulated telescope focused on an illuminated wire (0.001 in. in diam) mounted on the carriage. To obtain maximum contrast for viewing the wire it has been mounted across a small opening in a black paper box. The accuracy of displacement readings can thus be determined to about 0.001 in.

The pulse calibrator consists essentially of a three-mass system suspended from any convenient support by means of a wire hanger. Before it can be used to calibrate accelerometers, the calibrator itself must be calibrated. In order to do this, the third mass, M_3, is pressed toward the first, M_1, and held by a pawl in a sprung position at one of six steps on a rachet. When the pawl is drawn to release mass M_3, the second mass, M_2, experiences a pulse of acceleration having two frequency components, 12 and 30 cps. The second peak of this acceleration is taken as the calibrating pulse. This peak, which rises gradually from zero, exhibits the characteristics of acceleration pulses frequently encountered in objects under test. The choice of springs and masses has been made so that the effect of the weight of the accelerometer under test on the g value of the pulses is practically zero.

The magnitude of the acceleration "pulse" corresponding to release from a given ratchet point was determined from the acceleration due to gravity, using an accelerometer as an intermediate standard. An NBS vacuum-tube accelerometer was first mounted on the calibrator and a record of acceleration for a $1g$ change was obtained by suddenly releasing the mass. The ratio of the amplitude of the second peak of the calibrator record to the amplitude of the $1g$ record was taken as the g value for the given ratchet point.

The operation of the pulse calibrator consists of suspending the calibrator with test accelerometer attached to mass, M_2, cocking to the desired ratchet point, and releasing the mass by drawing the pawl. The instrument, which weighs about 30 lb, can be set up in the field permitting "spot" calibrations of complete acceleration measuring systems.

Pipe-Line Progress

An article in the November, 1948, issue of the *Industrial Bulletin* of Arthur D. Little, Inc., reveals that during the next few years about 50,000 miles of pipe line will be laid for transmission of natural gas and petroleum crudes and products. The largest proportion, or about 19,000 miles of pipe, will be for natural gas within the United States; the next largest use will be for foreign crudes, using slightly more pipe than domestic crudes, the article states. The annual pipe-line review of the *Oil and Gas Journal* features this high level of activity, as well as some technical innovations.

Natural-gas transmission in the United States has become more important with a gradual shift in our fuel economy over the past several years. While the price of soft coal has increased 117 per cent since 1932, with other fuels rising in proportion, the sales price of natural gas has decreased 12.4 per cent. Because of its improving competitive position, use of natural gas has expanded much more rapidly than that of either oil or coal. Peak demand cannot yet be met in winter, despite transmission of more natural gas this year than ever before. Many eastern utility companies hope to mix their manufactured gas with natural gas, with its higher heat value, to serve more customers through existing mains, now taxed to the limit.

Almost 70,000 miles of pipe are now used to carry natural gas. Greatest demand is in the Northeast, where population is greatest, while the natural-gas-producing areas are the Midwest, South, and Southwest. The Big and Little-Inch pipe lines, converted for natural gas, now have a capacity for 500 million cubic feet a day, with an expansion program expected to raise capacity to over 900 million cubic feet. A recently authorized pipe line from Mercedes, Texas, to New York, N. Y., will have a daily capacity of about 325 million cubic feet. It will be the largest single pipe-line project ever undertaken, with more than 1800 miles of pipe. Another integrated program for more lines to connect the Southwest and South with the Northeast, including New England, is expected to have a daily capacity of

over a billion cubic feet. Applications have been filed with the Federal Power Commission for construction of the proposed New England line only as far as Buffalo. The total, 2225 million cubic feet a day, is almost three times the amount piped into the Northeast in 1946.

Although lines for crude oil and petroleum products do not account for as much mileage as natural gas, they are important to our fuel economy. Approximately 5000 miles of domestic crude lines are planned, with another 1000 miles for products lines; about 2500 miles are now under construction. Much of this will connect West Coast refineries with large oil-producing centers in the Southwest, since no lines exist there today. Other projects will supplement existing lines to refineries in the oil centers, and increase the crude-oil capacity flowing to the refining areas of the Midwest and East.

Because the United States is now a net oil-importing country, and the Middle East has over half the world's total reserves, a gigantic effort is under way to make these vast oil supplies accessible to world markets. Projects in South America and Canada also total considerable pipe-line mileage.

Perhaps the most interesting pipe-line-construction story is that of the Trans-Arabian Pipe Line Company (Tapline) project between the oil fields of Abqaig on the Persian Gulf to Sidon on the Mediterranean, a little more than 1000 miles away. Despite the cost and difficulty of this task, it is justified economically by savings in shipping by about 900,000 tanker miles a month, depending on the size of tanker replaced, and in avoiding Suez Canal tolls. The amount of steel for the pipe line will be only 65 per cent of that necessary for tankers to handle the anticipated output of 500,000 barrels daily from the Persian Gulf fields. In about six years, Tapline's project, with other Middle East oil plans, will provide a total pipe-line outlet for nearly 1.5 million barrels daily. More than a hundred miles of pipe have been laid on the Tapline project.

Czechoslovak Industries Fair

A MILLION-DOLLAR showing of merchandise, consisting for the most part of items available for export to this country, was exhibited during the Czechoslovak Industries Fair at the Museum of Science and Industry, New York, N. Y., January 12 to February 5, 1949.

Featured items at the exposition included a rear-engine Tatra 87, eight-cylinder luxury limousine; motorcycles; cameras; a microscope which magnifies objects 2600×; textiles; ceramics; 75 styles of women's kidskin gloves and other items; rubber and leather goods; toys; shoes; the famous Bohemian glassware and costume jewelry; 25 patterns of fine china

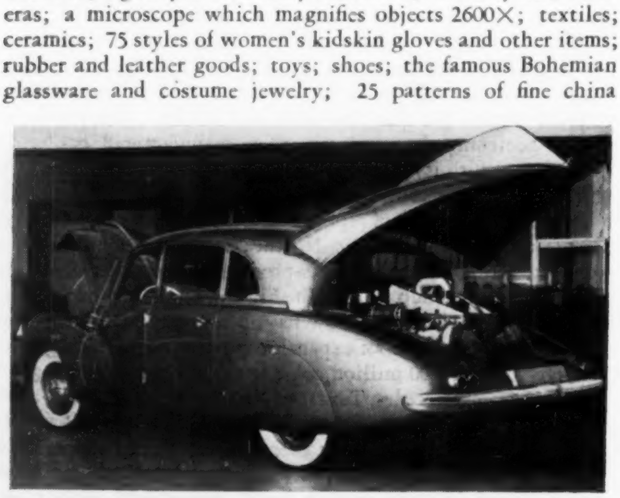


FIG. 6 REAR-ENGINE TATRA 87

dinnerware; and a wide assortment of typical products of the country.

The exposition, which was the first Czech trade show ever to be presented in the United States, will be taken to other American cities.

An objective of the fair is to increase both exports and import trade with the United States. Trade with the U. S. amounted to $20,000,000 in exports and $30,000,000 in imports from American industry in 1948, according to Dr. Karel Fink, Czechoslovak commercial attaché in New York.

The fair typified the Czechoslovak approach to international trade activity, evidenced by the annual Prague International Fair.

Perfumes and cosmetic items were among the new products introduced. Czechoslovak ornamental glass containers, long used by French perfumers, will serve as a styling feature to assist in boosting the new export merchandise.

Of particular interest was the Tatra, a five-passenger, rear-engined automobile. It is powered by an 8-cylinder V-type 75-hp air-cooled motor, air cooling being accomplished by a blast-engine V-belt drive. The Tatra has a 110-in. wheel base; it is 190 in. long, 65 in. wide, and 90 in. high, and weighs about 3000 lb. It has a maximum speed of 100 mph and a cruising speed of 85 mph. It has an all steel self-supporting body, four doors, all seating between wheels, sliding top, dropped flooring, and the front seats fold providing sleeping accommodations for two persons.

Materials Handling

AS the result of combined planning by one of the nation's large manufacturers of materials-handling equipment and a leading structural engineering organization, the Philadelphia Division of the Yale and Towne Manufacturing Company has a new home which should serve industry as a "proof by demonstration" of the unit-cost reducing value of proper plant layout and maximum use of modern mechanized materials-handling facilities.

The plant which is a 17-acre single-story structure was officially opened on January 10, 1949, the first day of the third National Materials Handling Exposition staged at Convention Hall, Philadelphia, Pa. Representatives of the industrial press participated in the ceremonies which included a conducted tour through the spacious structure, talks by company officials who discussed factors which influenced the design, and a demonstration at Convention Hall of the company's newest product, a new line of electric and gas-powered industrial trucks which carry loads up to four tons and lift them as high as 130 in. above the floor.

The new plant has a total floor area of 775,000 sq ft and is situated on a 93-acre tract of land on Roosevelt Boulevard opposite Northwest Airport about 12 miles from downtown Philadelphia.

In laying out the various departments every work station was planned for efficient production and handling at the machine, and each station was plotted in proper relation to the preceding and succeeding operation. Storage and manufacturing areas were arranged to provide a smooth flow of material from receiving to manufacturing to shipping through the shortest possible distance with minimum of handling.

By satisfying the principle that "production is material in motion," considerable reduction in manufacturing cost has already been achieved. In the old plant a typical part had 22 operations and was moved 45 times for a total distance of 10,140 ft; in the new plant, the same part moves only 3380 ft, a reduction of 67 per cent.

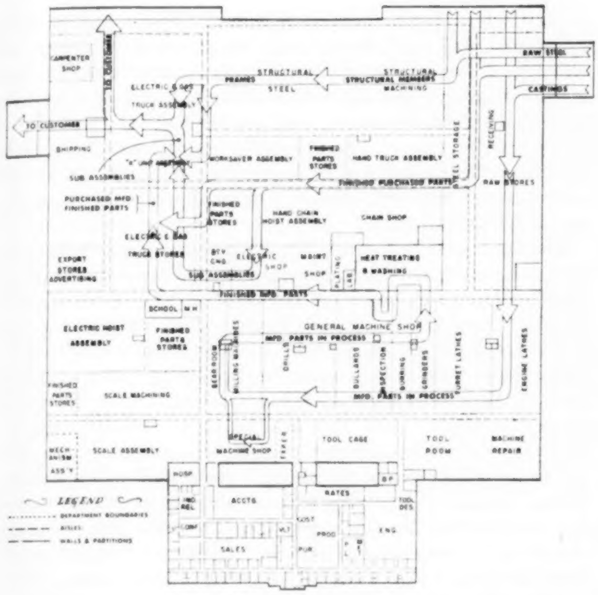


FIG. 7 LAYOUT OF THE NEW 17-ACRE PLANT OF THE PHILADELPHIA DIVISION OF THE YALE AND TOWNE MANUFACTURING COMPANY SHOWING THE FLOW CHART OF POWER TRUCK PRODUCTS

Impressive features of the plant are the ideal working conditions created by the near-daylight intensity provided by fluorescent lights and 36,300 sq ft of windows, a Fiberglas-insulated roof, thermostat-controlled unit ventilators, and spacious layout and accessibility of equipment.

The plant includes a cafeteria from which kitchen-prepared foods will be transported to heavily populated areas in the plant on three stainless-steel mobile canteens. These units have mechanically refrigerated and electrically heated sections for serving hot and cold foods.

A matter of pride to the company is the feat of moving from the old plant, installing equipment in the new one, and resuming operations with little loss in volume shipments and no loss of service to customers.

Coincident with the opening of the new plant was the first public demonstration of a new line of gasoline-powered lift trucks which make available for the first time in this class of equipment, the standard Chrysler fluid drive and a hydraulic lift actuated by a ram within a ram which gives two stages of elevation and permits stacking of materials to heights of 10 ft. Power is supplied by a 6-cyl 65-bhp Chrysler engine.

Color-Measuring Device

A NEW industrial color-measuring and comparison instrument designed to replace the human observer in precise color-matching problems has been developed jointly by the Instrument Development Laboratories, Inc., Williston Park, L. I., N. Y., and the Research Laboratories of the Pittsburgh Plate Glass Company. The instrument, called Color-Eye, incorporates the latest electronic and optical technique to simulate the response, sensitivity, and discrimination characteristics of the human eye. Inaccuracies due to stray light, variations in photocell characteristics, or illumination level variations are said to have been effectively eliminated by the basic design of the measuring system.

Color comparison is made on the tristimulus basis recommended by the I.C.I. as being equivalent to human vision for color-matching purposes regardless of the detailed spectrophotometric curve of the color samples.

In comparing samples, the instrument automatically "accommodates" itself to the illumination level of the samples, just as the human eye accommodates itself through its iris diaphragm, the retina, and the brain. The range of automatic accommodation is such that sensitivity is reported to exceed that of the human eye for variations in brightness of 10,000 to 1. This permits comparison of samples reflecting only 2 per cent to an accuracy of $^1/_2$ per cent of reflected light.

In order to make measurements that are truly based on color, regardless of illumination intensity, the device computes the ratio of sample brightness to standard brightness. This ratio is indicated on a wide-scale direct-reading meter with full-scale range of 90 per cent to 110 per cent (differences of plus or minus 10 per cent in brightness). A less sensitive scale range is provided covering 65 per cent to 150 per cent ratios. For all practical levels of illumination, the minimum brightness difference between two samples that is perceptible to the eye is substantially constant at 2 per cent of the mean brightness level. In terms of Color-Eye meter readings this represents a brightness ratio of sample to standard of 98 per cent or 102 per cent.

A direct-reading micrometric slit permits evaluation of tristimulus color values relative to standard whites. Approximate luminosity, weighted for the human eye spectral sensitivity curve, may be read directly on a logarithmic scale from 0.5 per cent to 100 per cent.

The instrument is suited to diversified uses, and it is claimed that it will measure reflection or transmission samples of almost any physical dimensions from $^1/_2$ in. minimum diameter. Compactness of design and lightness permit easy portability.

The optical system of the device is based on the flicker photometer principle to insure maximum stability of operation. A general schematic of the system is shown in Fig. 8 (the actual system is "folded" for compactness). Illumination is provided by an incandescent light source within an integrating sphere; color temperature is preserved by voltage control. Reflectance samples and standard are placed at ports in the sphere. The associated optics includes four lens elements, necessary field stops, stray light stops, source filters, tristimulus filters, and a photomultiplier as the photosensitive element. Source filters permit comparison under simulated

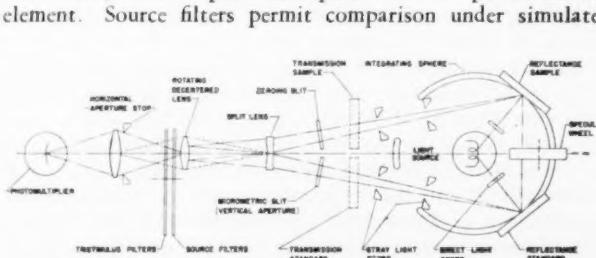


FIG. 8 OPTICAL SCHEMATIC OF COLOR MEASURING DEVICE

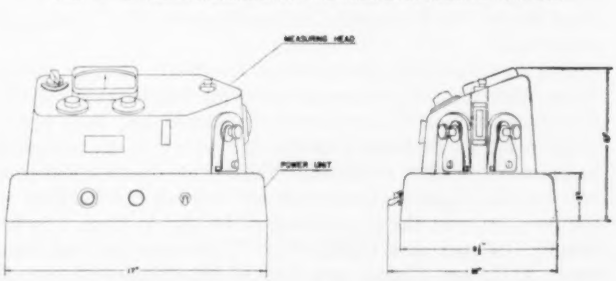


FIG. 9 OUTLINE DRAWING OF COLOR INSTRUMENT

incandescent, daylight, or selected fluorescent source. Specular components may be excluded or included. For comparison of surfaces having different texture and gloss characteristics, combined diffuse and direct illumination can be used, with viewing at the optimum angle relative to the specular component from the direct source.

The electronic system automatically measures sample and standard reflectances (or transmissions) and performs all computations required to determine luminosity and per cent brightness ratio. The components of the power supply are mounted in the separable base of the instrument, so that the measuring head may be lifted from the base and carried to large or immovable samples; electrical connections are maintained through a flexible plug-in cable for such use.

Russian Uranium Deposits

CONTRARY to popular impressions, a fair amount of authentic information has been published on the uranium resources of the Soviet Union, writes D. B. Shimkin, Russian Research Center, Harvard University, in *Science*, Jan. 21, 1949.

According to the article, Russian research on radioactive minerals began in 1900–1903 in the Fergana Valley of Russian Central Asia. Beginning in 1909 the Imperial Academy of Sciences initiated more ambitious investigations. All previously gathered information was sifted carefully, so that field work in 1911–1913 could be concentrated on the most promising localities: the Fergana Valley, Siberia, the Caucasus, Transcaucasus, and Urals. By 1914 indications from the Caucasus and Transcaucasus had become negative. In the Urals no indication of deposits of sufficient size for commercial exploitation could be found. Two areas appeared promising. One was Tyuya Muyun in the Fergana Valley, with deposits of tyuyamunite, $Ca(UO_2)_2 \cdot V_2O_8 \cdot 6H_2O$, closely comparable to the carnotite of the American southwest. The other was the northwest slopes of the Khamar-Daban Range, especially near Slyudyanka, and along the Trans-Siberian railroad between Baikal and Kultuk immediately across Lake Baikal, characterized by sites rich in mendelyeevite, with the probable composition, $2\ CaO \cdot 2(Ti,U)O_2 \cdot (Nb, Ta)_2O_5$, strikingly similar to betafite and allied niobium-tantalum-uranium minerals of Madagascar.

In 1941 a three-year program of research was authorized for the Academy of Sciences. The largest sums were to be devoted to expeditions in the Baikal area and the Fergana Valley, with lesser amounts going for investigations of the placer monazite deposits of the Transbaikal and for various minor projects. While World War I prevented full accomplishment of the program of the Academy of Sciences, enough was done to establish that only the Fergana Valley and the Baikal area had possibilities of commercial development. By 1918 the new Soviet government began pressing for the resumption of laboratory and field investigations of radioactive minerals; on Jan. 1, 1922, scattered radiological facilities in the USSR were combined in the Governmental Radium Institute of the Academy of Sciences.

This new Institute concentrated its efforts on the site of Tyuya Muyun. An important reason for this decision was the fact that small-scale commercial operations had been begun there in 1908. Between 1908 and 1913 the Fergana Company had mined 2,088,000 lb of ore, 1,512,000 lb of which had been sent to its plant in Leningrad for refining. According to company records, the ore contained, on the average, 2.36 per cent V, 0.97 per cent U_3O_8, and 3.73 per cent Cu. Scientific study of Tyuya Muyun was pressed throughout the decade 1924–1934.

The Tyuya Muyun deposit is a vein field in highly metamorphosed Paleozoic limestone, closely—but probably not genetically—associated with extensive karst channels and caves. The vein field consists of at least five barite ore veins bearing uranium, vanadium, and copper minerals, and of over 30 pure barite veins. The productive veins are found near the center of the deposit. The barite veins extend up to 1500 meters from the center; the maximum depth of the main vein may reach 500 meters.

The ore bodies within the productive veins vary in thickness from 1.5 meters to a few centimeters, and correspondingly in length. Run-of-the-mine ore averages 1.5 per cent U_3O_8, with a range of 0.6 to 4.0 per cent, the higher values being found in the lower horizons. However, the uranium oxide content of the amorphous, brown, cuprouranium carbonate lenses associated with the karst stalagmitic core runs from 26.12 to 50.25 per cent. Also noteworthy are the uranium-free radiobarites—$(Ba, Ra)SO_4$—and radiocarbonates—$RaCO_3$—established in relatively high concentrations at both lower and upper horizons of the deposit. The irregularity of the Tyuya Muyun deposit has made impossible the estimation of reserves; the mine produced 534 metric tons of hand-sorted ore in 1925–1926. By 1936 the quantity of radium extracted from the Tyuya Muyun ores and from radioactive waters near Ukhta was enough to meet the needs of the Soviet Union.

Explorations in other parts of the Fergana Valley have also been undertaken. In 1928 numerous indications of intense radioactivity were discovered in the western part of the Valley, but no uranium deposits. In 1923, however, the discovery of a uranium deposit at Uigar-sai or Atbash on the northern side of the Fergana Valley was reported. Geologically, the site was said to be closely similar to carnotite deposits in Colorado and Utah. It is characterized by young stream-deposited lenses of urano-vanadium ore, some of considerable size and richness.

A comprehensive survey of metallogenesis in the western Tian Shan range also gives brief details of other newly discovered deposits at Taboshar and Maili su. In the first of these, uranium pitch (pitchblende?) is associated with bismuth glitter, wolframite, arsenopyrites, and sulphide polymetallic (lead, zinc) deposits. According to a report of 1928, the indicated uranium content of the ore is only of the order of 0.12–0.2 per cent, which probably deprives it of economic significance. In the second site, infiltrations of urano-vanadium compounds are associated with tertiary limestones. Neither site was being commercially exploited in 1940.

In evaluating the significance of the Central Asiatic sites, it should be noted that, according to the Soviet prospecting plan for 1940, search for uranium and radium was to be concentrated in that area.

Two other recent finds of uranium-vanadium ores in Central Asia may be mentioned. In 1937 a deposit at Agalyk was reported; petrographic analysis of surface finds here established that tyuyamunite was the most frequently occurring ore. The geology of the site remained unclear; some evidence of primary deposition existed, but secondary hydrothermal deposition could not be excluded. Sampling at ground-water depths (50–60 meters) would therefore be necessary to establish the potentialities of the site; no data are available as to whether such sampling has been undertaken. In 1940–1941, the presence of uranium was established in a vanadium site in the northwestern tip of the Karatau Range. It represents a sedimentary deposit with subsequent metamorphism which has created a reiterated interbedding of thin bands of vanadium ores (with uranium-mineral accumulations) with flint bands. The total amount of uranium in the ore body (which extends for 25–30 km, with a thickness of 10–14 meters)

is great; but the improbability of finding large pockets of uranium and the difficulty of separating the disseminated uranium from vanadium on a large scale are serious obstacles.

In the area of the Khamar-Daban Range, serious investigations have been undertaken only at Slyudyanka, which is significant as a phlogopite mica deposit.

From an economic standpoint the results at Slyudyanka seem to be negative, for mendelyeevite was found only in the pegmatite veins of two parts of the deposit, in which it appears generally to play a subordinate role. The productive sector (Zayavka No. 5) consists of a large mass of Pre-Cambrian crystalline limestones, penetrated by a 200-meter-thick band of biotite and biotite-granitic gneisses, which in turn are interlaced, in places virtually engulfed, by the thick pattern of pegmatite veins in which mendelyeevite has been found. The bulk of the phlogopite veins of the sector are associated with the pegmatite-gneiss zone of contact.

Despite the seemingly negative picture at Slyudyanka, the widespread development of formations closely resembling the productive sector of this deposit from the Sayan Range northeastward to the Aldan gold fields cannot be ignored. A genetic association may exist between niobium-tantalum-uranium ores and phlogopite mica; their immediate proximity in Central Madagascar (Volonandrongo and Ambatofotsy) raise unanswered questions. Thus the discovery of three major phlogopite mica deposits in the Aldan gold field area—Emeldzhik, Kuranakh, and Chuga or Ust Nelyuka—heightens the probability of corresponding uranium finds to an unknown degree.

In brief, concluded Mr. Shimkin, Soviet discoveries of uranium in Central Asia within the last decade, while in no sense approaching the great significance of the African and Canadian deposits, appear to provide a possible basis for the development of atomic power in that area. It must be stressed that all of the Central Asiatic deposits are found within a radius of 250 miles from the important hydroelectric plants of the Tashkent area, which produced 882,000,000 kwhr of energy in 1943. Labor, transportation, and climatic conditions are also favorable here.

Possibilities for the discovery of significant uranium deposits associated with pegmatites in the region between Lake Baikal and the Aldan gold fields, and in the Ukraine, also exist.

Mercury Steam Plant

THE first postwar mercury unit-power-plant equipment has been placed in operation in the South Meadow Station of the Hartford Electric Light Company, Hartford, Conn.

Designed and supplied by General Electric, the equipment uses mercury vapor at 113 psig at 945 F to drive a mercury turbine at 720 rpm. The unit generates 15,000 kw while also supplying about 200,000 lb of steam per hr at 400 psig at 700 F to drive existing steam turbines.

Hartford's system combines the mercury-vapor cycle and a steam cycle into a binary system for producing power from fuel with greater thermal economy than is possible with the steam cycle alone.

The mercury-steam cycle consists of a mercury boiler, in which liquid mercury is vaporized at a comparatively low pressure; a mercury turbine, powered by the vaporized mercury; a generator, driven by the mercury turbine; a mercury condenser; a boiler, where the heat given up by the condensing mercury is used to convert water into steam which is used to drive the existing steam turbines.

The new installation replaces a smaller unit that has been in service for 20 years. Prior to the war there were only two large mercury-turbine installations in the world.

Hartford Electric Light Company has been the pioneer utility in the mercury-turbine field, working closely with General Electric to produce an efficient unit for superposing on steam installations. The few mercury turbines installed so far have all been "topping" applications. A topping application is one in which the mercury-unit power plant is superposed on existing steam turbines to raise the temperature range through which the power cycle operates.

It is expected that more mercury-unit power plants will be installed in the future, according to G-E engineers. They point out that the mercury cycle offers a simple and profitable means for producing power and has a wide range of applications.

Masonry Chimneys

TO help alleviate the housing shortage, Paul R. Achenbach and Seldon D. Cole, of the National Bureau of Standards, revealed that lined masonry chimneys built of shale-tile or cinder-concrete blocks are the equivalent of lined brick chimneys in draft-producing ability and effectiveness. It was pointed out that the masonry chimneys are cheaper, more easily erected, and lighter in weight than brick chimneys.

They spoke before the 1949 Annual Meeting of the American Society of Heating and Ventilating Engineers in Chicago, Ill.

The authors' quest for information on various types of chimneys was spurred on by the demand for cheaper materials created by the construction of small dwellings on a mass-production basis in recent years.

They built 14 chimneys using brick, shale-tile, and cinder-concrete blocks with fire clay and metal liners. All chimneys were of the same height (15.5 ft) but with different masonry materials for the walls, different size and type of liners, and different treatments of the air space between the liner and the chimney wall.

Each chimney had about two thirds of its height inside a building and one third exposed above the roof. The constructions selected for the various chimneys permitted comparison with brick chimney performance and tests were conducted under conditions simulating those obtained in domestic chimneys.

All tests were made at times when there was a negligible movement of air around the chimney. The method used consisted of blowing air through a calibrated orifice, thence over a gas burner into the chimney. Tests were made at 200 F, 600 F, and 1000 F inlet temperatures, and at gas-flow rates of 20, 45, and 70 cfm, which corresponded to fuel-burning rates of $^1/_2$, 1, and $1^1/_2$ gal of fuel oil per hour, respectively.

Conclusions on the performance of the masonry chimneys under steady-state conditions were as follows:

1 A chimney with an enameled-steel lining surrounded by one inch of granular insulating material produced slightly more draft than a refractory-lined chimney of the same internal diameter at low rates of gas flow (20 cfm), but no appreciable difference was apparent at higher gas flow rates. The chimney friction was practically the same for the 7-in-diam metal lining and the 7-in-diam refractory lining when both were clean.

2 A 7-in. round flue lining is not the equivalent of a 7 $\times$ 7-in-sq lining in capacity. The available draft increased successively in the 7 $\times$ 7-in. liners as the gas-flow rate was increased from 20 to 70 cfm, whereas it increased slightly in the 7-in. round liner for increasing flow from 20 to 45 cfm and decreased between 45 and 70 cfm. The friction loss was measurably greater in the 7-in. round flue linings at a gas-flow rate of 70 cfm in the square liners.

3 A 10-in-diam flue liner and a 7 × 11-in. rectangular liner having equal internal areas produced about the same available draft, had about the same loss of draft due to friction, and had equal effectiveness under comparable conditions.

4 In a chimney containing two contiguous liners, one liner operating alone while the other was open at the bottom, produced from 10 to 15 per cent less draft than a chimney containing only one liner of the same size. When both liners received flue gases at the same temperature each produced a draft nearly equal to that produced by a chimney with only one liner.

5 Sealing off the air space in the base of a new well-constructed chimney at the bottom of the thimble had no important effect on the draft produced.

6 Grouting in the liner of a masonry chimney with mortar did not decrease the average flue-gas temperature in the chimney or the available draft produced.

Although information was obtained on the several specimens for only one chimney height, the authors said, the results observed for chimneys made of shale-tile and cinder-concrete blocks were so nearly equivalent to those obtained for brick chimneys that the results for brick chimneys may be safely used for all practical applications.

Magnetic-Induction Drive

A MAGNETIC-induction drive called "Dynatork Drive," which eliminates the conventional clutch, has been installed by the Clark Equipment Company, Battle Creek, Mich., in a Clark gas-powered fork-lift truck of 6000 lb capacity. The new type of drive is said to give a smooth, quiet, efficient transmission power.

Power from the truck's engine is transmitted by means of magnetic induction. Two magnetic coils are mounted within the flywheel and are surrounded by magnetic poles. They rotate with the flywheel and are the driving members—one coil for "forward" and the other for "reverse." Two rotors attached to a special forward-and-reverse constant-mesh gearing, are the driven members. The magnetic inductive force is applied through an air gap and as a result there is no metal-to-metal contact between driving and driven members.

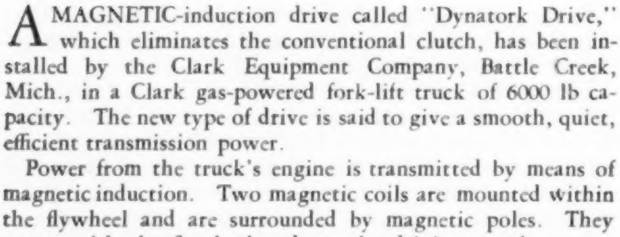


FIG. 10 PHANTOM VIEW OF MAGNETIC-INDUCTION DRIVE

A selector-switch on the steering column provides finger-tip control of truck movement. The switch has three positions, forward, reverse, and neutral.

Two gear ratios, high and low, are provided and selection is by means of a hand lever in the familiar floor-board position. Normally, the truck performs all its functions in high; the low is used only for extreme grades or unusual operating conditions.

Since there is no metal-to-metal contact between driving and driven members with the magnetic-induction force being applied through an air gap, there is no need for the conventional clutch. The special forward-and-reverse constant-mesh gearing eliminates the conventional transmission.

In a special demonstration the fork truck was driven forward at an average operating speed and the selector-switch was flipped abruptly to reverse. The machine pulled down swiftly and smoothly to a stop, then instantly and with equal smoothness started backward.

Sanitary Engineering

DEFENSE against atomic and bacterial warfare makes the need for training sanitary engineers especially acute yet none of America's Armed Services offer any incentive to draw qualified personnel into the Services or to build a competent sanitary organization in any of them, it was brought out before the 1949 Annual Meeting of the American Society of Civil Engineers by Prof. H. G. Baity, University of North Carolina, Chapel Hill, N. C.

He said that substantial progress has been made in recent months toward a clearer definition and response in regard to the role of the sanitary engineer in problems associated with nuclear-fission operations. The Atomic Energy Commission, under whose purview fall all matters relating to such operations, has now found it desirable to acquaint the profession with several aspects of these problems as related to environmental sanitation, reversing a policy wherein it first appeared that only the most limited participation of the profession in the development of safeguards would be permitted. It was argued aggressively and persuasively by leaders in the profession that protection of man and his environment against the hazards of radioactivity fell into areas of responsibility that could be serviced by the sanitary engineer. Therefore, it followed that the sanitary engineer should be made acquainted with the problems of nuclear-fission operations, especially in the disposal of wastes to the atmosphere, to the soil, and to surface waterways.

As to bacterial warfare, he pointed out, there has been no intimation yet—at least publicly—of the kind or scope of probable protective measures. It is not unlikely, however, that conventional tests for the detection of contaminants would have to be re-examined in order to provide more positive means for detection of pathogenic organisms during periods of possible attack. And since the means adopted for transmission of some diseases could be far different from those that operate under natural conditions, entirely new techniques for sanitary control might be called into application.

Asserting that the expansion authorized in the Army, Navy, and Air Forces will certainly result in an increased need for sanitary-engineering services, Professor Baity declared that conditions of employment and service will be such that they will appeal only to lower-grade men.

He pointed out that temporary assignments to active duty

plus the fact that the work is likely to be under the supervision of unqualified officers preclude the chance for satisfactory and profitable service. The postwar organization of the national defense represented in large part the resentment of the combat officers against the staff organization that existed during the war. No doubt the pendulum has gone too far. Until it returns, and the necessity for efficient utilization of technological personnel is again recognized, none of the Armed Services offers any attraction to the sanitary engineer. It may be years before an adequate balance is again achieved. It is not a question of any vested interest or right that the sanitary engineer may have in the military establishment; he has no such right, Professor Baity declared. It is a question of proper and efficient organization to deal with the manifold problems of environmental health in the Army, the Navy, and the Air Force. Under present conditions there is no incentive to draw qualified personnel into these Services or to build a competent sanitary organization in any of them. This situation is serious in peacetime; it might prove calamitous in wartime.

Low-Temperature Problems

MODERN U. S. Air Force cold-weather tests have been conducted on an increasing scale since 1941 at Todd Field, Alaska. Current production-type aircraft and engines are tested under actual low-temperature conditions to increase the Air Force's background of operating knowledge and to assist in its development programs.

The existing Air Force low-temperature limit of —65 F was established in 1942. This limit has been shown to be substantially sound although at present it is being questioned and Aeronautical Board Sub-Committee ANC-22 is now investigating this limit. For instance, during the 1946–1947 winter season a Western Hemisphere record low of —83 F was reported in the Yukon, while an Eastern Hemisphere low of —94 F was recorded in Siberia.

Oil systems still present a major problem in so far as Arctic operations are concerned. Oil is inherently an unsatisfactory medium to use because of its relatively high pour point. Reciprocating-engine oils are particularly bad.

Oil dilution is one means whereby satisfactory engine crankability and oil pumpability are provided under most low-temperature conditions. The basic Air Force oil-dilution system has long been satisfactory for use in the U. S. See Fig. 11.

This dilution system has been unsatisfactory under extremely low-temperature operations and investigations have been under way for several years to correct or modify oil systems so that satisfactory and consistent cold-weather operation would be obtainable with service-type aircraft. Fig. 12 shows progressive steps in the development of oil-tank hopper and sump details. The segregating-type system shown in Fig. 12 D has been satisfactorily used during preliminary testing in Alaska and indications are that this basic system will be successful.

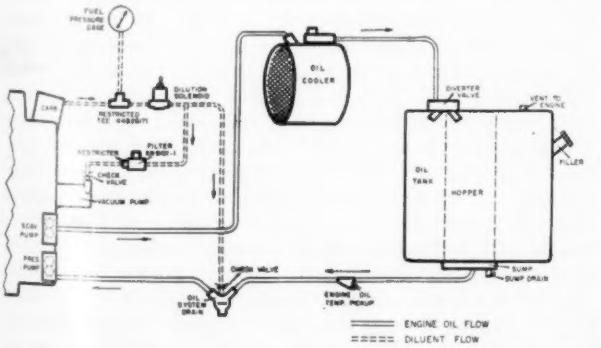


FIG. 11 SCHEMATIC LAYOUT OF STANDARD AIR FORCE OIL-DILUTION SYSTEM, INCLUDING VACUUM PUMP DILUTION INSTALLATION

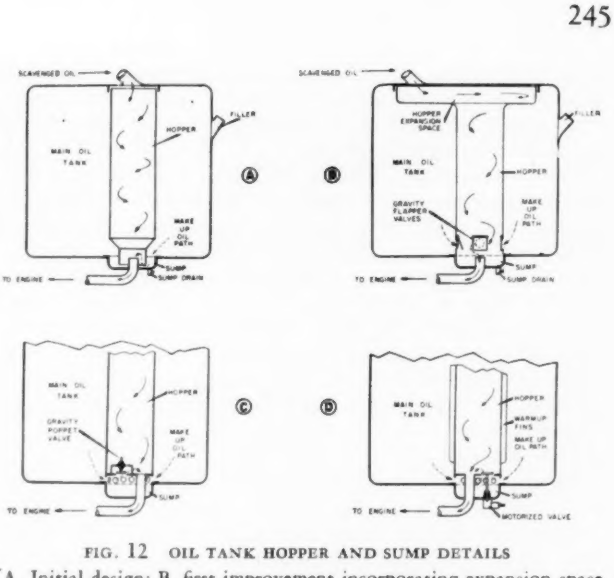


FIG. 12 OIL TANK HOPPER AND SUMP DETAILS

(A, Initial design; B, first improvement incorporating expansion space and flapper valves; C, poppet valve replacement of flapper valves; D, positive segregating hopper.)

In addition to this basic oil system circuit, experimental work is under way with a hot-tank oil system and a closed-circuit oil system. Neither of these two systems have ever been checked under low-temperature conditions and because of their special design features, the Air Forces will undoubtedly encounter additional and severe problems that will adversely affect the mechanics of dilution.

Reaffirmation is made of the necessity of oil dilution for successful Arctic operations. Oil dilution can and does provide engine crankability under conditions which would present extreme difficulties were it not used. Most important of all it provides for oil "pumpability and flowability" under starting conditions at oil locations where heat (if used) would not penetrate.

Cold starting of reciprocating engines has long been under investigation by the USAF and the engine industry. Reciprocating-engine starting has been successful and repeatedly accomplished in the laboratory at a temperature of —65 F using high vapor pressure for fuels, and also at the minimum field temperature encountered of about —55 F using similar special fuels. Some cold starts have been successfully made in the field at temperature ranges of —40 to —50 F using special high-pressure priming systems and regular-grade gasoline. Continued testing on this subject is presently under way.

In view of the fact that satisfactory and consistent dilution systems are not presently available on current aircraft, heat is still a basic requirement for operation under low-temperature conditions. When co-ordinated improvements are made in dilution systems and cold-starting systems, installations will be provided on current aircraft for low-temperature starting without heat. Ground heating equipment has improved greatly in the last few years and preflight heating procedures are considered normal. It must be remembered, however, that heating is time-consuming, requires considerable preparatory maintenance, additional equipment, and fuel. As USAF objectives regarding this subject, the following might be listed in order of importance: (1) Dependable and consis- craft operation, (2) operational improvem- cured by a minimum pen-

tions, or additional complications are concerned, (3) minimize preflight and preparation time so as to conserve man power, and (4) minimize additional supplies and equipment required to decrease the logistics problem.

The turbojet-engine starting situation is quite different from the reciprocating-engine starting. Much data of a positive nature, both quantitative and qualitative, have been secured in the last two years. Tests have been completed on the J-31, J-33, and J-35 engines using both JP-1 fuel and regular-grade gasoline down to temperatures of —65 F. Jet-engine starting can be satisfactorily and easily accomplished down to the minimum temperature limits using standard available fuels. Numerous tests conducted at both Ladd Field and Eglin Field, Fla., show that JP-1 fuel is not usable under normal operating conditions at temperatures much below 0 F, if normal engine life is to be obtained.

In all three turbojet tests, oil type AAF 3606 or An-0-9, Grade 1010, has been used with satisfactory results. Also, it has been shown that engine crankability is not a severe problem and can be successfully surmounted provided suitable external power sources are available.

Arctic experience has indicated that low temperatures adversely affect the operating characteristics of reciprocating engines. Rough operation and loss of power is commonly encountered particularly at low power cruise conditions. One of the most effective solutions to the problem has been the diligent use of carburetor heat. Substantial improvement in operation has resulted in many installations, but because of the lack of instrumental aircraft and suitable weather simultaneously, the Power Plant Laboratory has been unable to conclusively prove and show on a quantitative basis the effects of carburetor heat and/or variable cylinder-head temperatures on the quality of engine operations for all existing installations.

It is pointed out that at present there are not sufficient data on hand regarding the low-temperature effects on engine operation for both direct-fuel-injection engines and also turbojet and turboprop engines. Here, particularly, continued investigations seem in order.

Considerable emphasis is still to be placed on maintenance and accessibility. Many smaller problems still plague the USAF in so far as accessory equipment is concerned. Considerable difficulty and excess maintenance is still experienced due to malfunctioning of seals, gaskets, grommets, O-rings, hoses, diaphragms, etc., when subjected to low temperatures. Many internal seals of fuel-flow equipment still leak and cannot be corrected by normal maintenance. Hose connections and fittings plus gasketed surfaces all tend to leak because of cold flow.

Radioactive Waste Disposal

A NUMBER of leading members of the sanitary-engineering and waterworks engineering profession attended a two-day seminar on disposal of radioactive wastes, in Washington, D. C., Jan. 24–25, at the invitation of the U. S. Atomic Energy Commission.

This seminar is part of a continuing effort on the part of the Commission to maintain close liaison with public health and safety officials on mutual problems arising out of the national atomic-energy program.

In his introductory remarks at the first seminar meeting, David E. Lilienthal, chairman of the Atomic Energy Commission, pointed out that the problems of radioactive waste disposal and other atomic-energy problems must be discussed from the viewpoint that "we have to learn to live with radiation."

"Handling the waste-disposal problem is a part of learning how to live with radiation," Mr. Lilienthal continued. "The way we have learned to live with unfamiliar things before was to learn as much as we could about them; to keep our shirts on; not to get overly emotional or hysterical; not to escape from things by emotional outbursts.

"Radiation is just as much a natural phenomenon as anything else," Mr. Lilienthal said. "The fact that we have by intelligence multiplied it does not change that fact. I am sure there will be a good deal of shock, at first, as we get used to these facts. But I am sure also that just as we were able by our intelligence to conquer other things, we will conquer this as well."

In discussing health problems in atomic-energy activities, Dr. Shields Warren, director, Division of Biology and Medicine, AEC, indicated that it is possible to detect radioactivity at levels far below those dangerous to humans and that the problems dealt with are not unknown hazards. Radiation acts in two general ways, Dr. Warren said. External radiation comes from outside the body from the x-ray tube or from a source of radium or from an atomic pile. In so far as external radiation is concerned, he said, there is no hazard with proper shielding and proper application of known techniques of waste disposal.

Internal radiation, Dr. Warren said, comes from radioactive materials which are absorbed by the body having entered through the lungs or gastrointestinal tract. To prevent radioactive materials from being absorbed by human bodies is the prime objective of the radioactive-waste-disposal program, Dr. Warren added.

To the best of our knowledge, he continued, the precautions being utilized at atomic-energy sites are giving adequate protection.

Dr. Austin Brues, director of Biology and Medicine, at the Argonne National Laboratory, Chicago, Ill., discussed permissible limits and tolerances on radioactivity. Limits and tolerances are the tools used by sanitary engineers and waterworks engineers in protecting the public from hazards of all types including not only radioactivity but chemical poisoning, typhoid fever, and the like. Tolerances for radioactivity are determined in the same way as tolerances for these other hazards, through experimental research and observation of individuals who have worked with x ray or have been victims of radium poisoning over the past 50 years. In the matter of external total body radiation, the standardized tolerance level is one tenth roentgen per day. This applies to persons who are exposed to radiation continuously, day in and day out, as workers in x ray or atomic energy. Persons who do not receive continuous exposure can tolerate single doses of radiation of many roentgens without detectable damage, Dr. Brues said, and for certain pathologic conditions radiation treatment requires doses far beyond any than can be tolerated normally.

Roger S. Warner, director of engineering, and Arthur V. Peterson of the Production Division, Atomic Energy Commission, described the atomic-energy installations and processes which are sources of radioactive wastes. The amounts of waste materials produced at these sites vary by factors of several million, they said. A clinic treating a person with radioiodine or a research laboratory using small amounts of radiophosphorus in biological tracer work will create a very small problem, provided the physician or research worker takes normal known precautions. The larger research laboratories such as the Argonne National Laboratory, the Brookhaven National Laboratory, and the Oak Ridge National Laboratory produce considerably greater quantities of radioactive materials but the low permissible limits for radioactivity discharged into soil, air, or water are usually met through techniques of dispersion and dilution, and use of normal industrial decontaminating devices such as filters and scrubbers.

The radioactivity produced at the great atomic-energy pro-

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

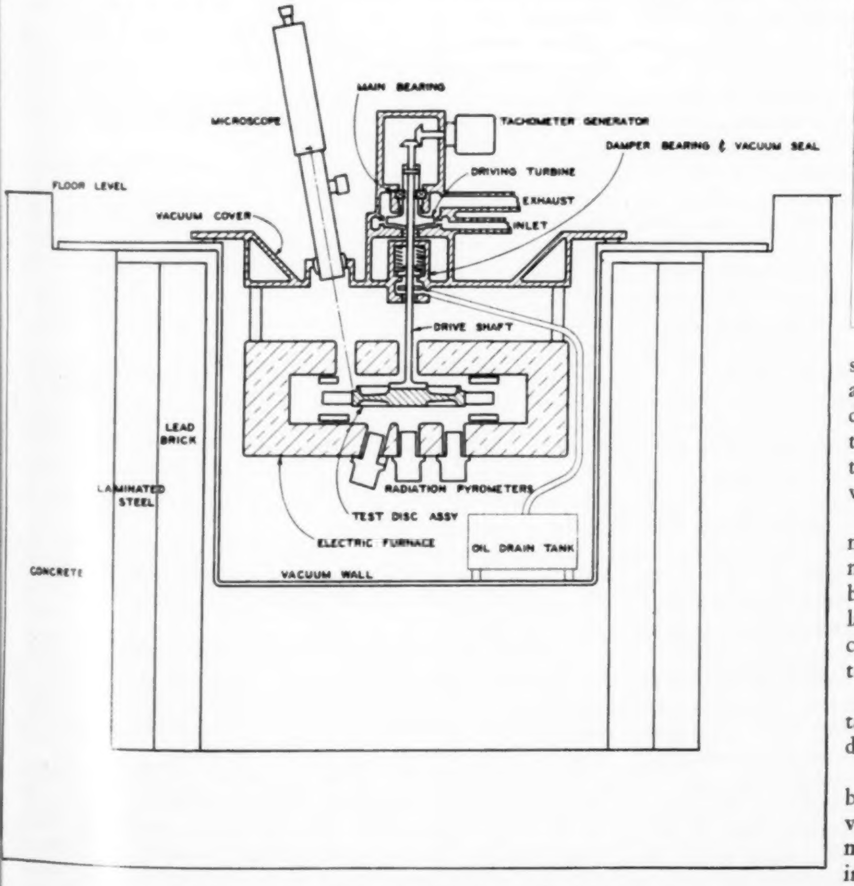
Gas-Turbine Blades

Hot-Spin Tests of Bladed Jet-Engine Rotors, by H. B. Saldin and P. G. DeHuff, Jr., Westinghouse Electric Corporation, South Philadelphia, Pa. 1948 ASME Annual Meeting paper No. **48—A-121** (mimeographed).

The creep-rupture and ductility characteristics of materials are of utmost importance to the designer of higher-temperature rotating parts.

Four-bladed disks were tested in a facility that was designed to spin the rotors in as near engine-operating conditions as possible. These parts were tested in accordance with a predetermined schedule of temperature gradient, temperature, and speed.

Creep-rupture tests are of value in determining the life of a given material under variable loads and temperatures. When it comes to evaluating the relative merits of materials suitable for use as jet-engine turbine disks, more complete testing is necessary. To be considered are the stresses due to thermal gradients and rotation; the effect of bolting restrictions and notches; and, related to all of these, the effect of ductility. Of particular significance is this intangible ductility. Most disk materials are very ductile at room temperature, but some are much less ductile at elevated temperature and some materials have little or no hot ductility after processing. Designers know that many of the currently used materials can be processed to have high strength with low ductility or low strength with high ductility. There has always been uncertainty of the minimum ductility for safety in a given application. One of the main functions of disk testing is to help evaluate this "strength versus ductility" situation.



LONGITUDINAL SECTION OF HOT-SPIN TEST PIT

Careful examination of the possible methods for selecting and testing disk materials revealed that the operation of bladed disks in an engine or under similar conditions would be the best way of combining the many variables into one test.

An analysis was made of the advantages and disadvantages of running bladed disks in an actual engine.

The analysis showed that although a bladed disk could be run in an engine for varying periods of time, there are not many conditions that can be varied during engine operation. Speed cannot be increased without seriously overloading

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duction centers, and particularly at Hanford, are of another order of magnitude, it was pointed out. Even at these centers many types of wastes of low levels of radioactivity are handled in the same fashion as at other laboratories. Very high-level wastes, however, are held at the site until the radioactivity decays, the material is reprocessed for its highly valuable components, or indefinitely. In the latter case the problem becomes one for the chemical engineer to deal with in designing proper types of equipment for concentrating highly radioactive materials into the smallest possible volume for convenient storage.

After radioactive wastes from the Oak Ridge, Tenn., plants of the Commission were discharged to the Clinch River, the level of radioactivity in that river was found to be considerably less than that in many of the mineral waters widely used in the United States for drinking, reported Dr. Karl Z. Morgan, director of the Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. The amount of radioactivity contributed from all Oak Ridge operations to the atmosphere of the neighboring area is less than the added cosmic radiation exposure one receives in going from sea level to Denver at 5000 ft elevation, Dr. Morgan added.

Methods for handling liquid radioactive wastes were described by W. A. Rodger, Chemical Engineering Division, Argonne National Laboratory. As a member of a committee which recently surveyed the problems of liquid-waste treatment at most of the major atomic-energy sites, Dr. Rodger reported that there is no evidence that present practices constitute an immediate hazard. Some current practices are potentially hazardous, he added, and it is doubtful if some others should be continued indefinitely or should be scaled up by a very large amount. Research work on better methods for treating liquid wastes has already shown that a decontamination factor of at least 100,000 is possible, Dr. Rodger said.

The possibilities of developing concentration methods for radioactive liquid wastes by biological processes similar to those now used in sewage treatment appear promising, according to Dr. C. C. Ruchhoft, of the Environmental Health Center, U. S. Public Health Service, Cincinnati, Ohio. It is believed that biological concentration methods will be less costly than chemical methods for removing radioactive contaminants from liquids, Dr. Ruchhoft said.

Methods of treating gaseous and solid atomic-energy wastes were described by Arthur E. Gorman, Division of Engineering, and the problems encountered in production, use, and control of radioisotopes were described by Dr. Paul Aebersold, director, Isotopes Division, Atomic Energy Commission, Oak Ridge.

In summarizing the sanitary engineering problems connected with atomic energy, Dr. Abel Wolman, head, Department of Sanitary Engineering, Johns Hopkins University, Baltimore, Md., called attention to the peculiar wartime circumstances which led to the establishment of the atomic-energy industry. It will be difficult for the industry to dislodge itself from these circumstances, he said, but this must occur if the industry and its special types of research are to permeate throughout the United States. Dr. Wolman predicted that the sanitary engineer and the water and sewage plant operators in the future will take on the function of protecting the water supply and the atmosphere of communities against the hazards of contamination by radioactive wastes just as they now protect communities against air and water pollution of other types. He urged that the biologists, physicists, and physicians reach agreement on permissible concentrations of radioactivity in soil, air, and water, and supply these data to the sanitarians. He pointed to the necessity of the sanitarians beginning at once to learn the new words associated with radioactive wastes, and to become acquainted with the use of the instruments employed to measure degrees of radioactivity.

Operator Toll Dialing

A MAJOR step toward establishment of faster, more accurate, long-distance telephone service has been completed with the installation of a new type of electronic telephone switching equipment in New York and Chicago long-distance centers, it was revealed by the Long Lines Department of the American Telephone and Telegraph Company, and the New York Telephone Company, at a press conference and special demonstration held on Jan. 6, 1949, in New York, N. Y.

The new switching equipment makes it possible for a long-distance operator to put through calls to distant telephones directly, without the aid of other operators en route. About one third of the long-distance calls originating in New York City are now being routed through the new equipment installed in the Long Lines Headquarters Building.

Ultimately, the Bell System plans to extend this method, called operator toll dialing, throughout the United States and Canada. A single operator will then be able to dial a number anywhere in the nation, just about as easily as a subscriber now dials a local call in his own city.

At the present time operator toll-dialing networks enable operators to dial calls straight through to the distant telephone in some 300 cities. Approximately ten per cent of the nation's long-distance calls are now being handled by this means. This figure will be greatly increased during 1949, as new automatic switching centers are scheduled to be established in Cleveland, Ohio, in June, and at Oakland, Calif., and Boston, Mass., in October. Albany, N. Y., will become a toll-dialing center in April, 1950. Hundreds of smaller communities will be linked to those centers, which in turn will be connected with New York, Chicago, and Philadelphia.

The new switching equipment installed in New York—which alone connects with some 70 major points—is in addition to the crossbar central office completed here last summer, which made it possible for operators in some other cities to dial New York City numbers directly.

The Bell System's program for nation-wide toll dialing is based on the development of electronic devices which determine and arrange the routing of calls—taking over where the human hand and brain were once essential. This ingenious equipment can select possible routes between distant cities, direct switching operations at intermediate points along a route, and complete connections automatically in a matter of seconds.

The nation-wide extension of toll dialing requires a numbering plan under which the entire country is being divided into about 80 numbering plan areas. Each of these will be designated by a distinctive three-digit code. Then each office within an area will be designated by a three-digit code, one which does not conflict with the code of any office within the area nor with any other area code.

Thus, the operator will generally be able to complete any toll call by dialing a maximum of 10 digits—the six digits of the area and office code and the four digits of the called telephone number.

In calling distant cities, the operator does not actually "dial" the numbers. Instead she uses a ten-button key set which is capable of working about twice as fast as an ordinary dial. Each time she punches a key a tone pulse is sent out over the regular voice channels to the switching center.

Each tone pulse is a combination of two different audible frequencies, which are sorted out and classified by the "brains" in the switching equipment, which then interprets their meaning. This switching equipment also provides the electronic "hands" which assume much of the complex switching operation.

other parts of the engine, particularly the turbine blades. Other items such as high cost and poor control of test conditions are additional cause for looking at a separate hot-spin test as the best method of performing the tests.

The Applicability of Ceramics and Ceramals as Turbine-Blade Materials for the Newer Aircraft Power Plants, by A. R. Bobrowsky, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1948 ASME Annual Meeting paper No. **48—A-135** (mimeographed).

Ceramic and ceramal materials have been investigated for use as turbine-blade materials for aircraft gas turbines. Tensile, flexure, thermal shock, and oxidation data for these materials at temperatures up to 2400 F are presented. These data are discussed with respect to applicability for turbine use. Results of turbine-blade operation at the NACA Cleveland laboratory are given.

The turbine blade is one of the most critical parts of a gas turbine. Although both the combustion chambers and the stator vanes operate in gas at higher temperatures than that passing the turbine blades, the combustor and stator components do not present great design problems because they are subjected primarily to thermal stresses alone and because they can be cooled by circulation of a gas or a liquid. The turbine blade, on the other hand, is subjected to centrifugal, vibratory, and thermal stresses, and is more difficult to design with cooling provisions because of high speeds of rotation.

It is well known that an increase in temperature of a gas turbine results in an increase of thermal efficiency of the unit. Present-day inlet-gas temperatures are about a maximum of 1650 F with occasional rises to as much as 2000 F (for example, during starting). This 1650 F gas temperature produces maximum turbine-blade temperatures of about 1500 to 1550 F. Increases in average gas temperature to 1950 F result in large increases in turbine thermal efficiency. The corresponding maximum metal temperature in the turbine blade would then be about 1800 F.

A number of ceramics and ceramals have demonstrated their excellent tensile properties at elevated temperature. Carbide-base materials possess good thermal shock resistance and operate cooler than most high-temperature alloys or oxide-base materials, although they may present oxidation problems and difficulties with wheel cooling. Both ceramics and ceramals have operated as blades in gas turbines at temperatures above those in service use with alloy blades, although speeds were lower. Lives of ceramic and ceramal materials are still short, primarily because of mechanical design problems that cannot be anticipated prior to research evaluation. Additional research is required on such factors as elevated-temperature fatigue properties before ceramics and ceramals may be considered competitive with heat-resistant alloys except for short-time operation.

Metal Cutting

A Constant-Pressure Lathe Test for Measuring the Machinability for Free-Cutting Steels, by F. W. Boulger, H. L. Shaw, and H. E. Johnson, Battelle Memorial Institute, Columbus, Ohio. 1948 ASME Annual Meeting paper No. **48—A-86** (mimeographed).

From the metallurgical viewpoint, machinability is probably best defined as a complex property of a material which controls the facility with which it may be cut to the size, shape, and surface finish required commercially. Attempts to measure machinability are usually based on determinations of tool wear, chip behavior, energy consumption, or rate of metal removal.

Because of the numerous variables involved, machinability ratings must be based on shop operations under comparatively uncontrolled conditions or on laboratory tests with conditions simplified by various assumptions. The latter method seems preferable.

In a general way, low strength and low ductility during cutting seem to be desirable for good machinability. Since these properties are mutually contradictory for most metals, the desired balance between them would be expected to vary for different machining operations. Consequently, it seems likely that steels which are good for certain types of cutting may be unsatisfactory for other machining operations. Caution should be exercised in using machinability ratings based on one type of cutting for predicting the behavior in other types of machining. For the same reasons, discretion should be used in accepting machinability ratings based on physical or mechanical properties rather than on performance in simulative tests.

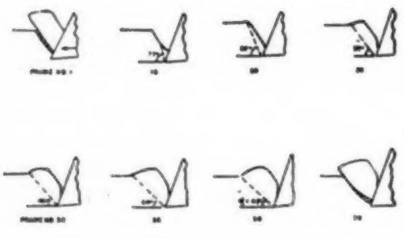
There are many types of laboratory machinability tests. Laboratory machinability tests usually involve machining operations, because investigators generally realize that knowledge of the nature of machining does not yet permit substituting another test in place of machining. Ordinarily, the machining operation, cutting fluids (if any), tool shapes, and tool materials are selected arbitrarily and held constant. The materials under study are then evaluated by measuring some other important variable believed to bear a close relationship to cutting quality. The quantity of metal removed per unit of time for a constant feed load or tool life, or the pressures, wear, or life of the tools under known conditions, are often used as criteria for machinability. Measurements of tool and work temperatures, or the amount of heat generated during cutting operations, have also been used for machinability comparisons.

This paper describes a machinability testing method developed during a cooperative research program at Battelle Memorial Institute sponsored by The Carnegie-Illinois Steel Corporation. The test evaluates materials on the basis of the feed resulting from a fixed horizontal tool pressure. Its advantage is that it requires only a short testing time. A description of the lathe and auxiliary equipment is given and typical testing results are presented.

The data indicate that the method has a high order of sensitivity and adequate reproducibility of testing ratings. Constant tool-pressure machinability test ratings were in close agreement with tool-life test values when the evidence indicated reliable sampling and in adequate agreement with large-scale commercial machining operations. The test seems to offer a means of rating the cutting quality of free-cutting steels rapidly and reliably with the use of small samples.

Mechanics of Formation of the Discontinuous Chip in Metal Cutting, by Michael Field and M. Eugene Merchant, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1948 ASME Annual Meeting paper No. **48—A-136** (mimeographed).

The process of metal removal results in chips which are broken up into segments, while in other cases chips are formed as continuous ribbons of varied length. H. Ernst has pointed out that there are actually three basic types of chips—Type 1, the discontinuous chip; Type 2, the continuous chip; and Type 3, the continuous chip with built-up edge. In a previous paper M. E. Merchant has made a fairly complete mathematical analysis of the geometry, mechanics, and plasticity conditions governing the formation of the Type 2 chip. The present paper formulates a similar analysis of the Type 1 chip.



SKETCHES TRACED FROM MOTION-PICTURE FILM SHOWING STAGES IN COMPLETE CYCLE OF DISCONTINUOUS CHIP SEGMENT FORMATION

In this type of chip formation, segments are formed by rupture which occurs intermittently on the shear plane as the cutting tool progresses. As the tool advances into the cut immediately following rupture of a segment, the metal is first deformed plastically and the angle of shear is large. Rupture is prevented during this stage by the fact that the compressive stress on the shear plane is high enough to permit the metal to undergo considerable shearing strain without fracture. As the tool progresses, the shear angle falls until the compressive stress becomes sufficiently low (or the shearing strain becomes sufficiently high) to permit fracture. The cycle then repeats.

Almost without exception, a discontinuous chip is formed in all machining operations carried out on such important materials as cast iron, brass, and bronze.

Pressure Vessels

The Collapsing Strength of Out-of-Round Vessels, by R. G. Sturm, Mem. ASME, and H. L. O'Brien, Purdue University, West Lafayette, Ind. 1948 ASME Annual Meeting paper No. **48—A-99** (mimeographed).

The problem of designing a vessel for external pressure is a complex one. Besides basic concepts of the strength of materials, cognizance must be taken of other factors contributing to this complexity, e.g., a vessel under external pressure embodies buckling characteristics much the same as a column under axial compression. Recognizing the idiosyncrasies of external-pressure vessels, the ASME Boiler Construction Code Rules for Construction of Unfired Pressure Vessels, Section VIII, 1946, has included, as Figure U-23, a chart for determining the allowable working pressure of vessels subjected to external pressure.

Figure U-23, Section VIII, is titled, "Chart for Determining Shell Thickness of Unfired Cylindrical Vessels Subjected to External Pressure When Constructed of Steel." Because the chart gives the desired information for cylindrical vessels which deviate a limited amount from perfection, an auxiliary set of design information was included as Figure U-25; "Allowable Difference in Maximum and Minimum Diameters for Unfired Cylindrical Vessels Subjected to External Pressure." This latter chart simplifies the designer's problem in allowing for unavoidable out-of-roundness due to fabrication tolerances.

Such allowances may be most easily made for external-pressure vessels by resorting to a chart which is an auxiliary to the fundamental design chart for perfectly round vessels. An equation for constructing these charts is presented herein and a method shown by which this end may be most easily accomplished, i.e., by separating the geometric properties of the vessel from the mechanical properties of the material. Sample computations are presented along with a completed chart showing the out-of-roundness tolerances for an external pressure vessel when constructed of A-Nickel. Charts alone are presented for stainless steel 17-7.

Aluminum-Alloy Vessels, by E. G. Kort, Aluminum Company of America, New Kensington, Pa. 1948 ASME Annual Meeting paper No. **48—A-108** (mimeographed).

The aluminum alloys are being found increasingly useful in industrial applications. Such characteristics as good thermal conductivity, lightweight, resistance to corrosive attack by many commonly used materials, no sparking tendencies, lack of effect on the product such as changing color or rendering it harmful to living organisms are some of the distinctive qualities that attract designers to the consideration of aluminum.

During the past three years there has been a decided increase in the demand for both aluminum storage and aluminum unfired pressure vessels. New products requiring aluminum-alloy processing equipment as well as aluminum's improved competitive position, as compared with most other metals, probably are two of the chief reasons for the increased interest.

Aluminum and aluminum-alloy storage tanks and unfired pressure vessels have been manufactured in limited quantities for many years. This article describes past experiences in designing and manufacturing vessels of aluminum. Included are some of the problems involved in meeting state and local code regulations. The paper presents general suggestions for designing, manufacturing, supporting, and inspecting aluminum tankage.

Manufactured Gas

Meeting the Peak Loads of Manufactured Gas, by E. S. Pettyjohn, Institute of Gas Technology, Chicago, Ill. 1948 ASME Annual Meeting paper No. **48—A-130** (mimeographed).

The meeting of peak loads requires an economic and physical balance between storage of raw materials, selection of gas-making equipment, location of production units, and storage of finished gas. This balance must provide for servicing all parts of the distribution system during periods of maximum demand.

It is shown that as the volatility or mobility of the fuel increases, its storage capacity decreases and its cost of storage rises. This increase is partially offset by an increased utility in the more mobile fuel. The less mobile fuels may be stored at very low cost and with little deterioration in quality. These properties plus the by-product credit have made coal the basic raw material in the majority of manufactured-gas plants.

The costs of gas storage will influence not only the location and character of the holders but will influence the location and type of production plant. It shows that storage costs decrease with increase in pressure. Storage under pressure has the further advantage of providing the mechanical energy required for distribution.

In manufactured-gas plants the normal disposition of equipment against variations in sendout is as follows: (1) Base load—by-product coke ovens; (2) seasonal load—carburetted water gas; (3) predictable load—carburetted water gas and gas storage; (4) abnormal peak load—propane-butane air mixtures.

The use of propane-butane air mixtures for meeting peak loads has been employed to a greater or lesser extent in practically every manufactured-gas property. Propane-butane air mixtures are higher in specific gravity than normal manufactured-gas mixtures and a higher-heating-value substitute gas is required to provide a constant thermal input to the burners of the customer's appliances.

The advantages of propane-butane air as a substitute gas are the simplicity with which it may be employed and the speed with which the equipment may be placed in operation. Propane-butane has been employed for reforming and cold enrichment on a limited scale.

Silicone Lubricants

High-Temperature Performance of Silicone Fluids in Journal Bearings, by J. E. Brophy and J. Larson, Naval Research Laboratory, Washington, D. C., and R. O. Militz, R. T. French Company, Rochester, N. Y., 1947 ASME Annual Meeting paper No. **47—A-114** (in type; published in Trans. ASME, November, 1948, p. 929).

This investigation covers the use of the dimethyl-silicone polymer fluids and methyl-phenyl copolymers at elevated temperatures. A specially designed, small-bearing machine was used at bearing temperatures of 325 F to 500 F and at ambient or plate temperatures as high as 650 F. Hard chromium-plated journals were used in conjunction with bearings of 89 per cent copper, 4 per cent tin, 4 per cent lead, and 3 per cent zinc alloy. Loads up to 8500 psi were carried at 425 to 500 F, and loads up to 13,000 psi at 180 to 200 F, using the dimethyl-silicone fluid. Comparisons are made of the lubricating characteristic of the two classes of silicone fluids investigated. For satisfactory operation, either a long break-in or a silicone pretreatment of the bearings is desirable. Data on safe operating temperatures and rates of increase of viscosity are presented.

This investigation is part of a larger program on the lubricating properties of silicones undertaken by the Naval Research Laboratory at the request of the Bureau of Ships. As previous experience was concerned with the dimethyl-silicone fluids, this investigation of high-temperature lubrication commenced using the dimethyl fluid. Since the methyl-phenyl copolymers exhibited better stability in oxidation tests at elevated temperatures, the commercial fluid, DC 710, was also used in this investigation.

Education

College-Industry Relations With Particular Reference to Placement and Orientation of Mechanical Engineering Graduates, by S. H. Graf, Mem. ASME, Oregon State College, Corvallis, Ore. 1948 ASME Fall Meeting paper No. **48—F-6** (mimeographed).

A comparison of mechanical engineering curriculums offered by the engineering colleges of the United States discloses that in its essentials the pattern of mechanical-engineering training during the past fifty years has changed but little. The core of the mechanical-engineering curriculum now consists, as it did in the early 1900's, of a groundwork in mathematics, physics, chemistry, drawing, shops, mechanics, materials, hydraulics, electricity, and thermodynamics together with various courses designed to accomplish the student's general education such as English, government, sociology, and economics.

In the early days the scope of engineering information was very limited as compared to the present. Parallel with the technological advancement, there has also been a very marked change in faculty-student relations. Also, though the college does not guarantee the graduate a position, provision is generally made either through an organized personnel department or through the less formal activities of departmental staff members to help the senior in his placement program. Industry itself is largely responsible for this change in attitude.

A few years ago a committee of the American Society for Engineering Education on Engineering Education After the War presented a comprehensive report urging a liberalizing of engineering curriculums and recommending that a minimum of 20 per cent of the curriculum content be devoted to the humanities. Most schools have made an attempt to meet the proposed requirements although the response is certainly not unanimous and generally falls short of the required 20 per cent suggested. Experiences at Oregon State College, corroborated by reports from a number of other heads of departments of mechanical engineering, indicate that when a student is definitely seeking employment in a certain industry, his best selling point, aside from general considerations of personality, is at least some preliminary training in a specialized field of that industry.

The number of 1948 graduates from the 164 principal colleges of the United States was 151,045. Of these, 80,451 were veterans which is an increase of about 58 per cent over those graduated in 1947. It is estimated that 1949 may be the peak year for veteran graduates and after that there will be a sharp decline. The broader experience and outlook of the veteran graduate should be an advantage and of value to the employer.

The following plans are suggested to support close contact and co-operation between industry and college engineering departments: (1) The supplying of literature, films, and occasional lecturers; (2) the supplying of materials for laboratory tests and small research; (3) laboratory equipment either by donation or at bare cost; (4) the support of fellowships.

Petroleum Mechanical Engineering

Automatic Drilling Feed Controls for Rotary Drilling Rigs, by W. S. Crake, Shell Oil Company, Inc., Houston, Tex. 1948 ASME Petroleum Division Conference paper No. **48—PET-4** (mimeographed).

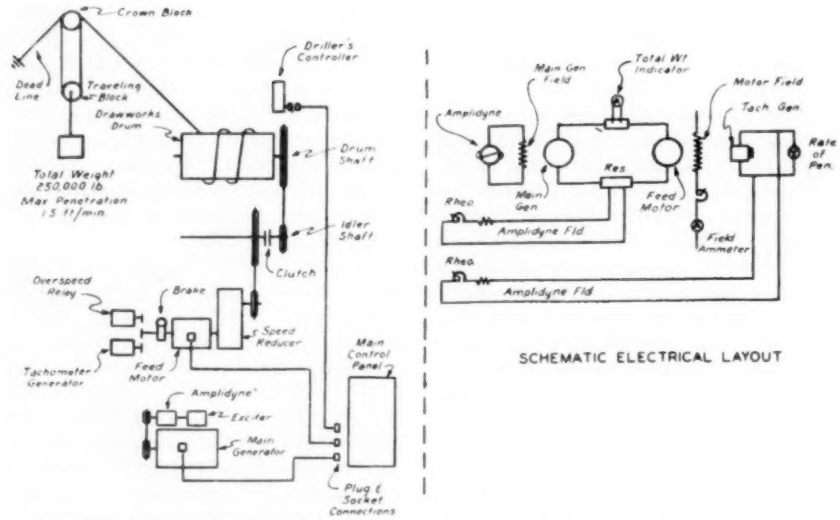
A considerable amount of detailed study and thought, design, and field testing of various means of achieving the desired results has gone to bring work on drilling controls to their present status. Up to the present, however, the results of this study and work have not been recorded except in improvement in machine performance. This paper is not primarily intended to be an evaluation of the results of automatic-controlled versus hand-controlled drilling, but it is felt that the subject is of major importance in reducing drilling costs and that all those factors which have been considered, and the analyses of the problems, should be placed on record.

It is pointed out that the hardest part of this work has been to study action and reaction of various controller machine parts on the well and piece together a reasonably accurate technical picture of the requirements of the job. The next most difficult job, with little previous experience, was to study and understand complex control instruments of various types and place them in the picture.

It has long been recognized that the maintaining of constant loading on drilling bits will result in more footage per bit and more footage per unit of time, all other factors being equal. The result is fewer round trips with their horsepower-hours, wear and tear on rigs, etc.

The best of hand-feed brake levers is a poor substitute for full-automatic control, since worn brakes creep off and either "drill off" or "pile on" weight. Most are worse than this in that they frequently drop off from $^1/_4$ to $^1/_2$ a drum revolution suddenly when worn. It is physically impossible for a man to feed constantly for long time periods, just as it would be on a lathe or other machine tool.

With automatic control, the driller can watch his drilling rate chart and his other drilling symptoms and adjust his feed weight and rotating speeds to obtain the best possible results. By making constant one of his drilling variables, i.e., the weight on the bit, the rotary speed automatically steadies down in any given formation and the table behavior becomes a very sensitive indicator of formation changes and types. The penetration rate indicator, or recorder, in most cases gives a clear graphic story of a bit becoming dull and



SCHEMATIC MECHANICAL LAYOUT

SCHEMATIC ELECTRICAL LAYOUT

AUTOMATIC ELECTRIC BIT-WEIGHT CONTROL

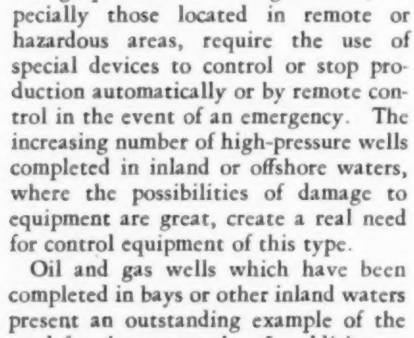
can save many additional hours "hoping the bit will make a few feet more."

Mechanical Controls for High-Pressure Oil and Gas Wells, by J. Ward, Humble Oil & Refining Company, Houston, Tex. 1948 ASME Petroleum Division Conference paper No. **48—PET-5** (mimeographed).

High-pressure oil and gas wells, especially those located in remote or hazardous areas, require the use of special devices to control or stop production automatically or by remote control in the event of an emergency. The increasing number of high-pressure wells completed in inland or offshore waters, where the possibilities of damage to equipment are great, create a real need for control equipment of this type.

Oil and gas wells which have been completed in bays or other inland waters present an outstanding example of the need for these controls. In addition to the severe potential damage to facilities from the effects of corrosion, there is considerable danger of damage resulting from collision with boats or other floating objects. The current trend toward increasing operations in the open and unprotected waters of the continental shelf presents the same type of problems in greater magnitudes.

These special mechanical controls discussed in the paper are divided into two general classifications, subsurface and surface controls, according to their location in the well and flow-line arrangement. Those controls which are installed within the well tubing and are generally used to regulate rates of flow, regulate pressures, or to operate as automatic shutoff devices when predetermined conditions occur within the tubing are designated as subsurface. The principal use of automatic surface controls is usually to obtain a safety shutoff or to maintain remote control of the well.



SECTIONAL VIEW OF A PISTON-OPERATED FLOW-LINE SAFETY VALVE

Field Control of Oil Field Pumping Equipment, by J. N. Gregory, Shell Oil Company, Long Beach, Calif. 1948 ASME Petroleum Division Conference paper No. **48—PET-6** (mimeographed).

The conditions faced by an oil producer in accomplishing continuous operation of surface pumping equipment without frequent attendance are outlined. The construction and application of devices to perform routine services on oil-well pumping equipment are described and particular attention is directed toward eliminating the services which ordinarily must be performed at frequent intervals. The need for a preventive maintenance program is outlined and the instruments and tools which may be used in such a program are explained. Certain devices for use at problem wells are discussed, and the value of operating procedures which consider routine service, preventive maintenance, and corrective measures is indicated.

Oil wells may be considered to fall into one of three categories; wells which should produce to capacity continuously, stripper wells which will produce to capacity without continuous operation, and wells with an allotment which is less than the productive capacity. Of these, the first is of the most concern since full-time operation at capacity is necessary if the greatest ultimate yield is to be realized, and to the cost of making repairs must be added the loss that may occur when production ceases. Thus the operator must select equipment capable of producing the well to capacity with enough allowance for normal wear so that an excess amount of time will not be required to replace worn parts, and he must also organize a service and maintenance routine which will assure continuous operation efficiently.

If down time through failure is to be avoided, equipment must be kept in good operating condition and imminent failure should be determined before a breakdown occurs. Three types of maintenance and repair service are required if the surface equipment is to be kept in first-class shape; routine service at frequent intervals to determine that the wells are pumping properly, to perform miscellaneous services such as adding oil and water to gas engines and lubricants to bearings, and to gage production rates; preventive maintenance at frequent intervals to determine engine performance and to inspect for worn or loose parts which may result in breakdown; and repair work as required to overhaul engines and replace faulty parts. There is no master plan which may be adapted to fit all conditions or fields, but if adequate preventive maintenance is inaugurated and devices are installed to do as much of the routine services as practical, it will be found that the time and work involved in pumping and down time from failure will be relatively small. A number of devices which have been developed to perform various services on oil-well pumping equipment are listed with a brief description of their construction and function.

Pressure Surges in Pipe Lines, by E. T. Skinner, Oklahoma A&M College, Stillwater, Okla. 1948 ASME Petroleum Division Conference paper No. **48—PET-7** (mimeographed).

Pressure surging in pipe lines is a problem confronting pipe-line companies today. Surges may create pressures more than double the operating pressure of the pipe line. These pressure surges may, in addition to causing equipment failure by vibration and fatigue, cause destruction of equipment and endanger human lives.

A pressure surge is a shock wave produced by the sudden increase or decrease of the velocity of a fluid. The phenomenon is usually referred to as water hammer.

Pipe-line pressure surges may be one of three types classified by cause, (1) pressure surge due to valve closure, (2) pump-suction line pressure surge due to interruption of flow into the pump cylinders, and (3) pump discharge-line pressure surge due to action of pump pistons.

Surges due to valve closure may be minimized by controlling the rate of valve closure. The rate should be well down in the slow-closure region unless some other means of surge relief is provided.

Surges of the other two types must be prevented from getting in phase. This is done by controlling the revolutions per minute of the pump and length of suction and discharge lines. Common headers are usually placed as close to the pumps as possible to reduce the possibility of phasing.

All three types of surges can be relieved by the use of open surge tanks. Open surge tanks are open to the atmosphere.

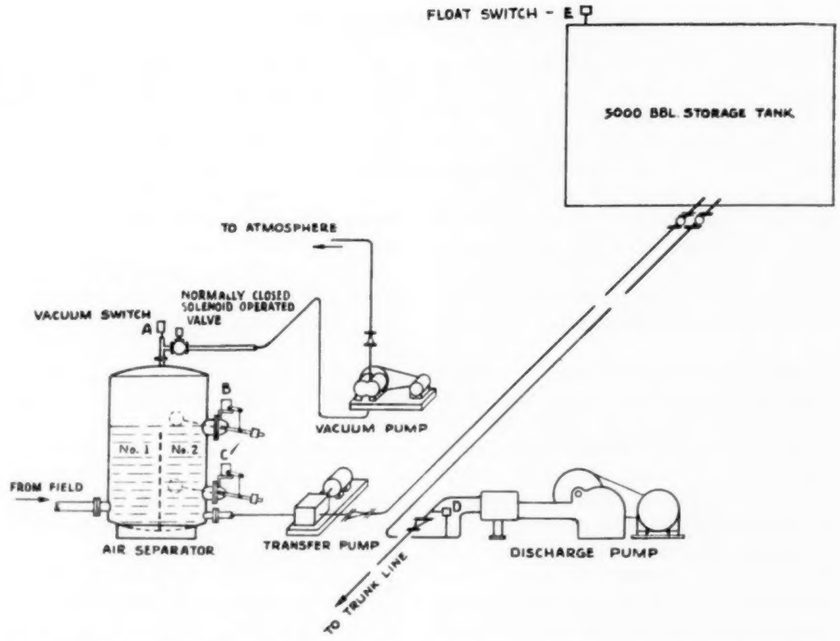
Another device suitable for relieving all three types of surges is the closed or pressure surge tank. There are several variations of this type of surge tank and they are discussed individually in the paper.

The use of interference waves is also a suggested possible solution for the problem of pressure surges.

Fully Automatic Electric Powered Crude Oil Gathering Stations, F. H. Warren, Ohio Oil Company, Findlay, Ohio. 1948 ASME Petroleum Division Conference paper No. **48—PET-8** (mimeographed).

An automatic electric-powered pumping station is described in this paper.

An air separator was installed in the gravity line from the field in order to take care of those cases when air is accidentally drawn into the lines. The separator tank is 5 ft in diam and 7 ft high, having a partition plate extending approximately $4^1/_2$ ft up from the bottom dividing the separator into two oil-tight compartments. A small Roots-Connersville blower driven by a 3-hp motor, was connected to the top of the air separator to pull out any air that might accumulate. A rotary transfer pump of approximately 200 bbl per hr capacity driven by a 5-hp motor was installed to pump the oil from the air separator to a 5000-bbl storage tank. A 4 × 6-in. pump, driven by a 20-hp motor, became the discharge pump. On the more recent installations, a sump has been added with a small-capacity, float-controlled sump pump. In case of excessive leakage, such as a blown gasket, the sump will fill up and cause a second float to shut down the entire station. All motor controls and electrical equipment are of the open type and are installed in a vaportight room.



SCHEMATIC ARRANGEMENT OF EQUIPMENT USED IN AUTOMATIC ELECTRIC FIELD STATION

The first automatic electric field station went into operation in December, 1945. Production handled by this station has increased from approximately 600 bbl to over 2000 bbl per day. The original 20-hp motor has been replaced by a 30-hp motor and the pump speeded up from about 70 bbl per hr to approximately 140 bbl per hr.

The automatic electric stations have been much more economical than the older type of station, utilizing engine-driven pumps. In most cases the power cost has been less than the cost of fuel, lubrication, and repairs of engine-driven pumps. There has been a slight reduction in man power. The district gager's job has been made easier because oil comes out of the lease tanks much faster. Evaporation loss has been reduced considerably. The first cost of the stations is quite reasonable and maintenance expense has been very low.

Pressure Surges and Vibration in Reciprocating Pump Piping, by J. W. Squire, Stanolind Pipe Line Company, Tulsa, Okla. 1948 ASME Petroleum Division Conference paper No. **48—PET-9** (mimeographed).

For pumping crude oil at the lower pressures (up to 900 psi), sufficient information is available for proper design of a piping system to avoid undue mechanical vibration. The design of low-speed duplex and triplex horizontal pumps is satisfactory at the lower pressures. The use of equalizer lines for two or more units on one system is a satisfactory practical solution at lower pump speeds and pressures.

The design of high-speed short-stroke pumps (175 rpm and greater) to handle large quantities of crude oil is not sufficiently worked out to avoid probability of breakage difficulties in the pump or piping. These factors become more important at the higher pressures now used.

The varying-grade crudes pumped, the use of a smaller number of large-capacity pumps, and the higher design pressures encountered on a modern pipe-line system complicate the proper design of a high-speed multicylinder pump. Solutions to these difficulties are being worked out in actual field installations at the present time. It has not been found

practical for the pump companies to set up laboratory installations for the size units used in a modern pipe-line pumping station.

The higher frequencies produced by the pump as pressure surges do not unduly complicate the problem of piping design. Avoidance of sharp discontinuities in the piping system and concentrations of mass or unsupported piping sections should result in a satisfactory piping system. The use of air chambers is not justified at surge frequencies above 20 cps.

The general requirements for suitable equipment for pressure surge and vibration measurements have been fairly well established. There should be no undue difficulties in setting up such a system with the exception of locating a pressure gage with suitable characteristics.

Several systems on the market for determining pressure variations have been studied for use in this work. These have consisted mostly of systems designed primarily for engine characteristics measurements and are not believed suitable for this application.

Filtration of Fuel and Lubricating Oils Used in Internal-Combustion Engines, by F. L. Townsend, Chicago, Ill. 1948 ASME Petroleum Division Conference paper No. **48—PET-10** (mimeographed).

The internal-combustion engine presents the most difficult problem of keeping the lubricating oil free of abrasive material. Excessive wearing of pistons, rings, and cylinder liners is noticed in internal-combustion engines. This excessive wear is accompanied often with high fuel and lubricating-oil consumption. This wearing forms small particles of metal which mix with carbon from unburned fuel and partially burned lubricating oil and makes a gummy deposit which is the cause of ring sticking. It is essential, also, to filter the fuel oil as a means of maintaining correct injector operation.

The contaminants or particles which form the deposits in the oil passages and inside an engine are the results of sedimentation and area of the size of particles which may be removed by filtration. Additives in the oil keep these small particles in suspension and prevent them from forming on the inside of the engine. Filters using absorptive elements are recommended for filtration of additive oils.

High flow rate through a filter is obtained by connecting the filter in the engine lubrication system as full flow, that is, the entire output of the lube-oil pump will flow through the filter shell. Such a method is also called the shunt method.

Filters connected as full flow should have a by-pass relief valve in the filter elements or installed in the filter shell which acts as an automatic pressure-relief valve.

Lube-oil filters should be connected as close to the engine as possible as hot oil tends for better filtration.

Cotton waste has proved quite satisfactory for many years as a filter medium. The cotton waste should be of the long-fiber, unbleached type. Waste which contains fibers of rayon and scrap materials should not be used. As cotton waste has an affinity for moisture the cotton-waste-type filter does much in maintaining a low neutralization number of the oil by preventing the moisture content of the oil from mixing with the sulphur content of the oil.

In general, the application of oil filters to an engine is to maintain a clean operating engine. There is no great problem of filtering oil but to keep an engine clean effectively does present the problem of selecting an oil, filter of such size which will remove foreign matter from the oil at the rate it is formed. It is also necessary to clean the filter when the dirt formation in the oil starts to accumulate beyond the dirt-holding capacity of the filter.

Wood Technology

An Educational Program For Wood-Using Industries, by L. A. Patronsky, School of Forestry and Conservation, University of Michigan, Ann Arbor, Mich. 1948 ASME Wood Industries Division Conference paper No. **48—WDI-10** (mimeographed).

There is a decided need for professionally trained men in an industry which finds that wasteful and haphazard methods of production must be replaced by precision manufacturing of parts to eliminate hand fitting. Many gluing and finishing problems that now plague the wood-using industry could largely be eliminated through testing and evaluating the quality of raw materials, careful control of the manufacturing processes, and humidity control in certain areas of the factories.

The wood-using industries have not, in the past, delved deeply into the inherent properties of their raw material. They have used it much the same as have generations past, disregarding the great possibilities which technological advancement could give them.

The wood-technology curriculum of the University of Michigan is designed to train men as engineers using wood as the raw material. The course offered covers subjects such as structure, physical and mechanical properties of wood, machine design, the gluing of wood, and in general, it prepares men to further, through research, technical knowledge of wood as a raw material and its efficient utilization in industry.

The wood-utilization laboratory at the University is used to extend basic knowledge about wood and to apply that knowledge in the solution of problems encountered by wood-products manufacturers. Projects for industry are contracted for by the Engineering Research Institute of the University and the work is supervised by the wood technology faculty members. The actual research is done by a staff employed by the Engineering Research Institute.

Close co-ordination between education and industry is bound to result in educational programs that provide adequately trained men, capable of becoming leaders in industry. To effect such co-ordination for students in wood technology, the School of Forestry and Conservation, together with the National Association of Furniture Manufacturers, planned a summer session at the University of Michigan Extension Center at Grand Rapids, which includes intensive training in all phases of the furniture industry from the planning of a new design to the shipping of the finished piece.

ASME Transactions for February, 1949

THE February, 1949, issue of the Transactions of the ASME contains the following:

Fuels Performance at Port Washington Station, W. A. Pollock (48—SA-7)
Combustion Studies Using the Golay Photothermal Detector With an Infrared Monochromator, J. T. Agnew (48—SA-16)
Performance Criteria for Positive-Displacement Pumps and Fluid Motors, W. E. Wilson (48—SA-14)
Response Characteristics of Thermometer Elements, A. J. Hornfeck (48—IIRD-2)
Designing for High-Frequency Induction Hardening, J. T. Temin (48—SA-32)
How Forging Acts to Enhance Metal Properties, E. O. Dixon and E. J. Foley (48—SA-60)
Shielded Thermocouples for Gas Turbines, A. I. Dahl and E. F. Fiock (48—SA-29)
Progress Report No. 2 on Tool-Chip Interface Temperatures, K. J. Trigger (48—SA-51)
Automatic Control of Turbojet Engines, C. S. Cody (48—AV-3)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Straight-Sided Splines

Comment by R. L. Cotta[1]

In the design of 10 and 16-spline fittings noted by the author,[2] it is important that the depth of the key be controlled so that the hob can be made to produce the spline by the generating action.

Heat-treating technique probably will be developed by either the induction- or flame-hardening process, which will practically eliminate objectionable distortion in hardened spline shafts. The involute spline would be better adapted for this field of application than would the straight key spline, owing to the buttressed core which would follow the contour of the tooth. The absence of clearance undercut also would favor the involute-type spline.

This hardening equipment would carry the work vertically through the heating zone into the quenching bath with timing control to produce specified results. Similar equipment is now in operation.

Comment by H. S. Sizer[3]

One of the questions recognized by the author and raised at several points in his paper is "Where, in practice, would straight splines be used in preference to involute splines?"

Straight-spline members can be hardened and then ground for a minor-diameter fit. Many companies are now grinding such splines and the operations can be performed on common grinding machines (surface and hole grinders). The grinding of involute splines is not a production operation and, at present, the advantage of straight over involute splines lies in the possibility of grinding hardened parts. Now, since straight splines with key or major-diameter fits do not offer the advantage of grinding, the writer's first recommendation would be that such bearing fits be dropped from the proposed standard for straight splines.

In general the great demand for straight splines has been centered on the 6-key series with a minor-diameter fit. Thus, it would seem that a standard for straight splines might be limited to 6 keys and that the 10 and 16-key series could be dropped. The involute-spline standard is generous in its offering of more than 4000 different splines, and for those cases of infrequently used straight-sided splines we should have no hesitation in recommending the substitution of an involute spline or of declaring such straight-sided splines "specials" outside the scope of the proposed standard.

A final recommendation would be to use three classes of fit rather than the five now proposed. Again, we would be forcing designers to use specials when they wanted extreme press fits or very free fits. This is desirable for in broad purpose a standard should discourage the use of odd sizes or fits rather than encourage their use by setting them up as standard splines.

Limiting the number of keys to 6, adopting a single minor-diameter bearing, and using three classes of fit instead of five would reduce drastically the number of splines to be listed in the proposed standard. Since it would also give a drastic reduction in the tools and gages required to produce standard splines, it is believed that such a move would be approved by machine-tool builders and most small shops.

Comment by A. H. Burr[4]

While the usefulness of the author's tables on the comparative torque capacities of hollow and splined shafts is readily understandable, in certain cases the tables may give rise to excessive factors of safety. In use of the tables a tabulated torque is divided by a stress-concentration factor, read from a chart, when there is a shoulder in the shaft adjacent to the spline. This division considerably reduces the torque capacity. The instructions for use of the chart would imply that the stress-concentration factor is to be applied under all circumstances of loading, whether the torque is steady, repeatedly applied from zero to a maximum in one direction, or completely reversed.

Many designers consider that for ductile steels the stress concentration does not contribute to failure under conditions of steady loading, that for complete reversal of loading the strength is reduced to a value found by dividing the steady-load strength by the stress-concentration factor, and that for intermediate conditions of load variation, the stress-concentration factor need be applied to the varying component but not to the steady component or mean value of the load. Formulas expressing these considerations were discussed by Soderberg.[5] For torque loading only, the equation solved for torque capacity is

$$T = \frac{1+R}{1+kR\frac{s_{sy}}{s_{se}}}\,\frac{s_{sy}}{n}\,\frac{\pi d^3}{16} = \frac{1+R}{1+kR\frac{s_{sy}}{s_{se}}}\,T_{st}$$

where k is the stress-concentration factor under torsional shear, n is the factor of safety, d is the shaft diameter, s_{sy} and s_{se} are the shear yield-point and endurance-limit values, respectively, T_{st} is the steady-torque capacity, and R is the ratio of the variable to the mean-stress component or, in terms of maximum and minimum torques, $R = (T_{max} - T_{min})/(T_{max} + T_{min})$. For steady loading $R = 0$, for repeated loading from zero to a maximum $R = 1.0$, and for complete reversal of loading $R = \infty$ and

$$T = \frac{1}{k}\,\frac{s_{se}}{n}\,\frac{\pi d^3}{16}$$

Torque loadings are not completely reversed in many shafts which turn continuously in one direction. For a stress-concentration value of 2.0 and a ratio $s_{sy}/s_{se} = 1.2$, the foregoing equations indicate the torque capacities under the repeated-loading condition $R = 1.0$ and the reversed-loading condition $R = \infty$, to be, respectively, 59 per cent and 42 per cent of the capacity under steady loading $R = 0$. Probably for many shafts the torque condition approaches the steady

[1] Machine Tool Engineer, Barber-Colman Company, Rockford, Ill.

[2] "Straight-Sided Splines," by J. B. Armitage, Mechanical Engineering, vol. 70, September, 1948, pp. 738–742.

[3] Gear Engineer, Brown & Sharpe Manufacturing Company, Providence, R. I. Member ASME.

[4] Head, Department of Machine Design, Cornell University, Ithaca, New York. Mem. ASME.

[5] "Working Stresses," by C. Richard Soderberg, Design Data Section, *Journal of Applied Mechanics*, Trans. ASME, 1935, p. A-108; also "Factor of Safety and Working Stresses," by C. Richard Soderberg, Trans. ASME, vol. 52, part 1, 1930, paper APM-52-2.

condition at which the capacity approaches 100 per cent. Thus the practice of the author's company relative to fillets would appear to be excessively conservative if applied to shafts in general. On the other hand, if at the fillet there exists the possibility of unpredictable bending stresses, completely reversed each shaft revolution, direct division of the steady-torque capacity by a stress-concentration factor may be desirable even for steady-torque conditions.

Author's Closure

Regarding the comments by Mr. Cotta, it should be kept in mind that if the 10 and 16 straight-sided fittings are desired, they can be produced with cutters instead of hobs but probably in the near future the involute type of spline will be substituted.

Mr. Sizer is probably right that the introduction of the involute splines has greatly reduced the necessity for the key fit or major-diameter fit in the straight-spline series and probably the 10 and 16-key series could be dropped. The author, however, does not recommend the three classes of fit rather than the five, as we have found that the three classes of fit do not cover all the uses to which the straight-sided splines are put.

Replying to Professor Burr's remarks, it should be kept in mind that the four tables, Figs. 6, 7, 8, and 9, were compiled by several of the engineers of our plant for the guidance of the engineers and designers in our Engineering Department. They were largely a compilation of existing data at that time (about 1931). They are largely based on a table by C. W. Spicer published as an SAE data sheet in 1918 and a paper also by C. W. Spicer, "Torsional Strength of Multiple-Splined Shafts," published in the Transactions of the Society of Automotive Engineers, 1921, page 391, part I, and modifying factors taken from a paper, "Torsional-Stress Concentrations in Shafts in Circular Cross-Section and Variable Diameter," by Lydik S. Jacobsen, published in the Transactions of The American Society of Mechanical Engineers, 1925, page 619. We would like to emphasize that in our plant we are never dealing with steady torques, and a stress concentration is dangerous. From our experience we know that our procedure does not lead to excessive factors of safety, since we still do have breakages. The formulas given by Professor Burr are those recommended by Westinghouse engineers of the East Pittsburgh Works for the determination of factors of safety when the cross section is not complex, as in a circular shaft or prismatical bar. These formulas were never recommended for general application. Sometimes we calculate the torsional stress in the fillet directly and in that case, we use Sonntag's approximate analytical formula which is in very close agreement with the exact solution.

J. B. Armitage.[6]

[6] Vice-President in charge of Engineering, Kearney & Trecker Corporation, Milwaukee, Wis. Mem. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Frontiers of Flight

Frontiers of Flight: The Story of NACA Research. By George W. Gray. Alfred A. Knopf, New York, N. Y., 1948. Cloth, $6 \times 9^1/_2$ in., illus, diags., ix and 362 pp., $6.

Reviewed by John Alden Briggs[1]

George William Gray, author of "Frontiers of Flight," has been writing about the advance of science for the past twenty years. Among his books which have received a wide acceptance are "New World Picture," "The Advancing Front of Science," "Education on an International Scale," "The Advancing Front of Medicine," and "Science at War."

The outstanding characteristic of Gray's works is the fluidity and readability of his style in which he presents scientific facts and theories in a manner which even the layman can readily understand. Gray has that rare quality of making even the most complicated theorem interesting and plausible.

It was his book "Science at War," published in 1943, that brought him to the attention of the executives of the National Advisory Committee for Aeronautics who commissioned him to write a history of the NACA. Gray worked closely with all sections of the NACA for the better part of three years in writing this interesting book.

"Frontiers of Flight" is the story of the NACA from its founding in 1915 up to the present. It presents the significant contributions of this body in fundamental aircraft research without which the astounding aircraft production of World War II would never have been achieved.

This is not a complete history of all aeronautical research but a selection of some of the outstanding results of the entire program. It is the story of tremendous expansion of the original small body at Langley Field, Virginia, in 1917, to its present size with additional huge laboratories; the Ames Laboratory at Moffett Field, California, and the Flight Propulsion Research Laboratory at Cleveland, Ohio.

Gray takes up the development of the wind tunnels and other tools necessary to the new field of aeronautical research; the effects of hydrodynamics as well as aerodynamics, and the necessary compromise between the two; compressibility and the sonic barrier; new airfoils and bodies; the problems of stability and control; load-factor problems, structural problems, propeller development, reciprocating-engine development including fuels, lubricants, and metallurgy; jet propulsion; use of heat against ice, and its corollary, refrigeration against high temperatures induced by air friction; and finally transonic and supersonic flight.

On the surface one might think that the subjects listed would be of interest only to a technician. That this is not true is a tribute to Gray's skill in presenting his subject. As, for example, in his chapter on "Speed," in which the sonic barrier is discussed, the often perplexing use of Mach number is thus explained: "A plane is traveling 409 mph at 36,000 feet. The speed of sound at 36,000 feet is 660 mph, and by calculation 409 is 62 per cent of this. The speed of the plane is thus 62 per cent of the speed of sound, or Mach number 0.62."

[1] Secretary, The Wings Club, Inc., New York, N. Y.

In explaining the sonic barrier Gray satisfactorily states, "You may wonder what sound waves have to do with it. Why should they condition aircraft performance? The answer is that the speed of sound is the speed of pressure propagation. As the airplane pushes forward, it compresses the air, sets up pressure waves which travel out in all directions at the same rate—and this rate is the speed of sound."

He continues ". . . As the speed of the plane is increased, the pressure changes grow more violent, but the speed of the pressure waves remains the same at any given altitude. At an aircraft speed of 400 mph, the message travels 260 miles faster than the airplane, at 600 mph for the plane the pressure waves are only 60 miles faster."

It becomes readily apparent then, that the sonic barrier is that point where the airplane trys to push through the pressure waves it is sending out.

"Frontiers of Flight" should appeal to a very wide segment of the scientific world. The fundamental research pursued by the men of the NACA is universal and applicable to all fields of science. Furthermore, it should appeal to everyone in the rapidly expanding field of aeronautics.

George Gray has done the world a great service in presenting the story of the NACA which, in the larger sense, is also the story of aviation.

Light Metals in Structural Engineering

LIGHT METALS IN STRUCTURAL ENGINEERING. By L. Dudley. Temple Press Ltd., London, E.C.1., England, The Macmillan Co., New York, N. Y., 1947. Cloth, $5^1/_2 \times 8^1/_2$, illus., 216 pp., $6.50.

REVIEWED BY J. F. YOUNG[2]

THIS book is written as a text for practicing engineers and draftsmen. It is especially appropriate in helping to fill the need for information relating to the ever-growing application of light metals in industry.

The presentation follows the classical topics of strength of materials with some discussion of structures. In addition two chapters are devoted to the mechanical properties of materials, one to the properties of aluminum and magnesium, and one to comparison of the properties of other materials of engineering with those of the light metals.

The coverage, particularly of the chapters on strength of materials, is of the elementary type. Many practical cases are reviewed, application data are included, and the manner in which properties of light metals affect application in various structural forms is discussed. Some calculus is used where necessary.

Probably of greatest value to the practicing engineer are the many practical examples incorporated with each topic. These should be of considerable assistance to those who refer to and apply strength considerations but seldom.

The book is typical of English works in its conciseness and clarity. Perhaps of a disadvantage to engineers in the U.S.A., however, is the usage of English notation instead of the standard nomenclature more familiar in this country.

It is believed by the author that the book will be especially useful to two groups—the engineer with basic training but with limited knowledge of the possibilities of light metals and those having practical experience in materials who lack the knowledge of the strength of materials which will aid application.

[2] Engineer, Advance Engineering, A&M Dept., General Electric Company, Bridgeport, Conn. Jun. ASME.

Rocket Development

ROCKET DEVELOPMENT: Liquid-Fuel Rocket Research, 1929–1941. By Robert H. Goddard, edited by E. C. Goddard and G. E. Pendray. Prentice-Hall, Inc., New York, N. Y., 1948. Cloth, $5^3/_4 \times 9$ in., illus., xx and 291 pp., $6.50.

REVIEWED BY JAMES R. RANDOLPH[3]

DR. GODDARD'S leadership in the development of rockets has long been recognized. His career is an outstanding example of what private initiative can do to develop a new invention, a new branch of engineering, and a new industry, thereby giving a free country a long head start over any dictatorship.

The foreword by Harry F. Guggenheim, and the introduction by the editors tell of Dr. Goddard's earlier work, of his later work with the Navy, results of which are still secret, and of the vast amount of material left behind at his death in 1945. This material is being made available for technical and historical research, and for publication.

All but the last chapter of the book consists of Dr. Goddard's own condensations of his notes, describing experimental work on liquid-fuel rockets between 1929 and 1941. The last chapter was prepared by the editors, following as closely as possible his style and his technique in summarizing the results of his work.

In 1929 Col. Charles A. Lindbergh became acquainted with Dr. Goddard's work, and was instrumental in securing the financial support of the late Daniel Guggenheim. This enabled Dr. Goddard to expand his activities, first at Camp Devens, Mass., and later at Roswell, New Mexico. He had already built a rocket using gasoline and liquid oxygen and had made flight tests of it. His work from then on consisted in the perfection of this design.

There were many difficulties. Combustion-chamber temperatures ran into thousands of degrees. Liquid oxygen boils at nearly three hundred degrees below zero. Rockets must be very light, yet strong. They need control of far greater precision than that of a torpedo, and their operation must be wholly automatic. Destructive and dangerous explosions are the normal results if things go wrong. All these difficulties were patiently dealt with as they arose, and the results are set down in this book, the good and the bad together, for the guidance of future experimenters.

The Germans followed the published results with great interest, and the reader familiar with their work will notice that Dr. Goddard was far ahead of them in the development of all of the types they used. Here are the beginnings of the V-1 or "buzz bomb," and here also the beginnings of the long-range pump-fed V-2. The only improvements the Germans made in the latter were the use of graphite steering vanes, and the use of hydrogen peroxide to operate the turbine for driving the pumps.

The editors are also distinguished in the field of rocket development. Esther C. Goddard, Dr. Goddard's wife since 1924, was his most valuable assistant. She is an honorary member of the American Rocket Society. G. Edward

[3] Professor, Pratt Institute, Brooklyn, N. Y. Mem. ASME.

Library Services

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Pendray is one of the founders of the American Rocket Society, and is one of its directors. He is the author of the well-known book, "The Coming Age of Rocket Power," and of many articles in this field. He is consultant on rockets for the Daniel and Florence Guggenheim Foundation, of which Harry F. Guggenheim is president.

Books Received in Library

COMMON SENSE IN STEEL TREATING. By W. R. Bennett, author and publisher, Brattleboro, Vt., 1948. Leather, $5\frac{1}{4} \times 7\frac{1}{2}$ in., 86 pp., $2. This small book is presented for the purpose of solving the difficulties constantly turning up in the daily life of the man whose duty it is to harden steel. It deals with specific problems causing trouble, points out dangerous steps, and advises methods to eliminate them entirely, thus preventing the recurrence of similar situations.

FLOODS, THEIR HYDROLOGY AND CONTROL. By H. K. Barrows. McGraw-Hill Book Co., Inc., New York, N. Y., Toronto, Canada, London, England, 1948. Cloth, $6 \times 9\frac{1}{4}$ in., 432 pp., illus., charts, maps, tables, $6.50. This book considers the basic features of flood hydrology and their application to the problems relating to control projects. Somewhat detailed descriptions are given of the more important great floods in the United States and their resulting damage. In addition to the analysis of the use of reservoirs for flood control, the features of local flood-protection work are discussed. A group of typical problems relating to flood-control projects is appended.

GEOGRAPHICAL DISTRIBUTION OF ENGINEERING RESEARCH AND RELATED INDUSTRIES IN THE UNITED STATES. Technical Publication No. 481. By H. M. Conway, Jr. Southeastern Research Institute, Atlanta, Ga., January, 1948. Paper, $8\frac{1}{2} \times 11$ in., no pagination, diagrams, charts, maps, tables, $2. Surveying the research establishments of the nation, this volume affords a basis of comparison of engineering research and development activity in various sections of the country. It appraises the present distribution of activity, analyzes the causes, and suggests means by which undesirable conditions can be minimized in the future.

HIGH-SPEED AERODYNAMICS. By H. W. Sibert. Prentice-Hall, Inc., New York, N. Y., 1948. Cloth, $5\frac{1}{2} \times 8\frac{1}{2}$ in., 289 pp., diagrams, charts, tables, $6. Dealing with both the subsonic and supersonic ranges, this book analyzes the various aspects of the flow of a compressible fluid past a solid body. The effects of certain wing types and of high airplane Mach numbers on airplane performance are discussed. A knowledge of the calculus and elementary aerodynamics is the minimum prerequisite.

INTERNAL COMBUSTION ENGINE. By C. F. Taylor and E. S. Taylor. Revised edition. International Textbook Company, Scranton, Pa., 1948. Cloth, $6 \times 9\frac{1}{4}$ in., 339 pp., illus., diagrams, charts, tables, $4.25. In the revised edition of this basic text the authors have clarified and amplified the subject matter. Recent experimental data have been included. Most important changes are found in the chapters on friction, air capacity of 4-stroke engines, 2-stroke engines, and engine performance. A discussion of the basic principles of gas turbines and jet engines has been added as a final chapter.

Introduction to GAS-TURBINE AND JET-PROPULSION DESIGN. By C. A. Norman and R. H. Zimmerman. Harper & Brothers, New York, N. Y., 1948. Cloth, $6 \times 9\frac{1}{2}$ in., 286 pp., illus., diagrams, charts, tables, $5. Designed for the beginner in the field, this volume deals with gas turbines for stationary, aircraft, marine, and locomotive plants, and also with rockets. It goes thoroughly into both the performance and design of gas-turbine and jet-propulsion apparatus. The book is well illustrated, including nearly two hundred figures, as well as performance graphs, and photographs.

MATHEMATICAL SOLUTION OF ENGINEERING PROBLEMS. By M. G. Salvadori with a collection of problems by K. S. Miller. McGraw-Hill Book Co., Inc., New York, N. Y., Toronto, Canada, London, England, 1948. Cloth, $6 \times 9\frac{1}{4}$ in., 245 pp., diagrams, charts, tables, $3.50. This book aims at widening the mathematical background of the student and at filling the gap between theoretical mathematics and the technique of solving physical problems. The six chapters deal with: fundamental ideas of mathematics, use of plane Cartesian geometry, solution of algebraic and transcendental equations, solution of systems of simultaneous linear equations, elementary functions of a real and complex variable, and the Fourier series. Illustrative problems are taken from elementary physics and mechanics and from the various branches of engineering.

National Advisory Committee for Aeronautics, NACA—UNIVERSITY CONFERENCE ON AERODYNAMICS, Papers, Langley Aeronautical Laboratory, Langley Field, Va., June 21–23, 1948. Durand Reprinting Committee, California Institute of Technology, Pasadena, Calif. Stiff paper, $8\frac{1}{2} \times 11$ in., 411 pp., illus., diagrams, charts, tables. This publication contains reproductions of some twenty technical papers presented at the NACA—University Conference on Aerodynamics held at the Langley Aeronautical Laboratory in June, 1948. The papers review the status of a number of fields of interest, summarize the more important wartime advances that are no longer classified, and orient reference material for further study. Supersonics, stability and control, and wing characteristics comprise the main groups considered.

OUTPUT AND PRODUCTIVITY IN THE ELECTRIC AND GAS UTILITIES, 1899–1942. By J. M. Gould. National Bureau of Economic Research, New York, N. Y., 1946. Cloth, $6 \times 9\frac{1}{4}$ in., 195 pp., charts, tables, $3. This book presents new measures of output, employment, fuel consumption, and capital investment in the electric, manufactured gas, and natural-gas utilities. The changing relation of output to the use of the various resources—labor, fuel, and capital—is described. The movement of electric and gas output and each of the input factors is traced since 1900. Retardation in rate of growth is discussed and compared with similar characteristics of other industries.

PRECISION MEASUREMENT METHODS AND FORMULAS. By J. Johnson. Pitman Publishing Corporation, New York, N. Y., and London, England, 1948. Linen, $6 \times 9\frac{1}{2}$ in., 181 pp., diagrams, tables, $3, 16s. Bridging the gap between "school" mathematics and practical application of theory, this book on tool inspection presents actual problems and their solutions. The over-all theory behind the solution is clearly shown. Solutions are for the greater part based on setups requiring the simplest of instruments. No special ability other than knowing how to use trigonometric tables is necessary.

PRINCIPLES OF HIGH-POLYMER THEORY AND PRACTICE, Fibers, Plastics, Rubbers, Coatings, Adhesives. By A. X. Schmidt and C. A. Marlies. McGraw-Hill Book Co., Inc., New York, N. Y., Toronto, Canada, London, England, 1948. Cloth, $6 \times 9\frac{1}{4}$ in., 743 pp., illus., diagrams, charts, tables, $7.50. Written as a college text, this book presents a comprehensive treatment of the fundamental principles, concepts, and practice applicable to all materials of high molecular weight. A broad co-ordinated approach has been maintained throughout in order to foster a basic understanding of the formation, properties, manufacture, development, fabrication and application of high-polymer materials. References are given to a number of books and recent articles in the field.

QUALITY CONTROL METHODS. By C. W. Kennedy. Prentice-Hall, New York, N. Y., 1948. Cloth, $6 \times 9\frac{1}{4}$ in., 243 pp., illus., diagrams, charts, tables, $4.75. This book supplies the necessary elementary information needed to understand the more technical and involved practices that modern quality control requires. It is a combination of the theoretical and practical. Acceptance sampling, batch control, distributions and the standard deviation, average and range, and administrative methods are the major topics considered.

SOLID AND LAMINATED WOOD BENDING. By W. C. Stevens and N. Turner. Department of Scientific and Industrial Research; His Majesty's Stationery Office, York House, London, W. C. 2, England, 1948. 71 pp., illus., diagrams, charts, tables, cloth, 5s. The book describes the various necessary equipment and processes for effective wood bending. It is largely a handbook of practice, but contains sufficient theoretical background to explain the adopting of the various procedures. Glue-setting methods are covered in the laminated bending section.

SPECTROSCOPY AND COMBUSTION THEORY. By A. G. Gaydon, with a foreword by Sir Alfred Egerton. Second edition revised. Chapman & Hall, Ltd., London, England, 1948. Cloth, $5\frac{1}{2} \times 8\frac{3}{4}$ in., 242 pp., illus., diagrams, charts, tables, 25s. In addition to the near visible and ultraviolet emission spectra, this text covers a wider range including the infrared region, the use of absorption spectra for following combustion processes, and the derivation of lifetimes of activated molecules. This second edition contains a new chapter on continuous spectra and the nitric oxide test for atomic oxygen in flames. Many sections have been rewritten and new material added. Some 300 literature references are keyed to the text material.

STANDARDS OF HYDRAULIC INSTITUTE. Eighth edition, 1947. Hydraulic Institute, New York, N. Y. Paper, $8\frac{3}{4} \times 11\frac{1}{4}$ in., paged separately, illus., diagrams, charts, tables $3. Of value to purchasers and users of pumps as well as to pump manufacturers, this volume contains pertinent technical and engineering pump data. There are sections on centrifugal, rotary, and reciprocating pumps, on miscellaneous data, and over 80 pages on pipe friction.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, ASME, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the Cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is submitted to the Board on Codes and Standards, for approval, as authorized by the Council of The American Society of Mechanical Engineers, after which it is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of December 10, 1948, and approved by the Board on Codes and Standards under the date of Jan. 5, 1949.

CASES ANNULLED

Case Nos.	Based on Revision of Pars.
845	U-140 to U-142
926	U-73
981	Emergency Specifications
1010	U-140 to U-142
1021	Specification SA-301
1027	U-128
1028	P-300, P-332(c)
1032	P-166(d)
1042	Specification SA-213
1044	U-77(b), U-201(d)
1045	Specification SA-285
1047	Table P-5
1048	P-294
1049	P-239, P-242, P-243
1052	U-140 to U-142
1056	U-13
1057	P-199(c)
1058	P-199(c)
1062	Tables P-7 and U-2
1066	P-106
1069	Specification SA-217

CASE No. 905 (Reopened)
(*Special Ruling*)

Inquiry: Is it permissible to construct welded vessels for use in the range of —150 F to 650 F under the requirements of Pars. U-68 and U-142 using copper chromium nickel steel or copper chromium nickel cobalt steel of the following chemical compositions and physical properties:

	Grade A	Grade B
Carbon, max, per cent	0.12	0.10
Manganese, per cent	0.55 to 0.85	0.35 to 0.55
Phosphorus, max, per cent	0.04	0.04
Sulphur, max, per cent	0.04	0.04
Chromium, per cent	0.65 to 0.85	0.65 to 0.85
Nickel, max, per cent	0.75	0.75
Copper, per cent	0.45 to 0.65	0.45 to 0.65
Silicon, per cent	0.15 to 0.30	0.20 to 0.35
Cobalt, per cent		0.40 to 0.60

All other requirements in accordance with specification SA-212.

The specification test bars are to be normalized and stress-relieved at 1100 to 1200 F prior to test. The Charpy impact requirements will conform to Par. U-142

Reply: It is the opinion of the Committee that the material specified in this inquiry may be used within the temperature range specified provided the provisions of Pars. U-68 and U-142 are complied with, and the material is normalized before welding. The maximum allowable working stress shall be not more than 12,000 lb per sq in.

CASE No. 1074 (*Special Ruling*)

Inquiry: May nickel-copper alloy in accordance with Specifications SB-127, SB-163, SB-164, and SB-165; nickel in accordance with specifications SB-160, SB-161, SB-162, and SB-163; and nickel-chromium-iron alloy in accordance with Specifications SB-163, SB-166, SB-167, and SB-168 be used in the construction of unfired pressure vessels under the Code rules? (Case No. 935 now permits the use of nickel-copper alloy in accordance with Pars. U-69 and U-70 construction.)

Reply: It is the opinion of the Committee that nickel-copper alloy, nickel, and nickel-chromium-iron alloy may be used in the construction of unfired pressure vessels under the Code with the following limitations:

(1) *Corrosion Resistance.* It is expected that vessels of nickel-copper alloy, nickel, and nickel-chromium-iron alloy covered by these rules will be used to hold liquids and gases corrosive to ordinary materials, or in the manufacture of substances where purity of product is of prime importance. The selection of an alloy suitable for the vessel's contents shall be the responsibility of the user. The determination of corrosion allowances are not covered by these rules.

It is recommended that users assure themselves by appropriate tests, or otherwise, that the alloy selected is suitable for the service intended.

Where service data are not available, the procedure of Par. U-11(*b*) should be followed.

(2) *Specifications.* The nickel and high nickel alloy material shall conform to the specifications set forth in Table 1.

(3) *Design.* (a) Maximum allowable design stresses shall be those given in Table 1.

(I) For fabrication by methods other than welding, the design stresses for the temper selected shall not exceed those shown in Table 1 for that temper.

(II) For fabrication by welding, all tempers of material listed in Table 1, except pipe and tubes, cold drawn-stress equalized, may be used. The maximum allowable stress that may be used in design calculations of welded joints shall not exceed the values shown for annealed material in Table 1.

(*b*) Since these alloys will be used for handling or storing corrosive fluids, care should be exercised to see that the design considers corrosion problems. Backing strips left on after welding, lap joints, and incompletely welded joints present crevices for local corrosive attack. Where the corrosive action is severe, such crevices should be avoided.

(*c*) Construction in accordance with Par. U-70, U-200, or U-201 will not be allowed.

(*d*) Joint efficiencies for Par. U-68 construction shall be 90 per cent, and for Par. U-69 construction shall be 80 per cent.

(*e*) In calculations of cylindrical vessels subjected to external pressure, the following charts shall be used for nickel-copper alloy, nickel, and nickel-chromium-iron alloy in place of Fig. U-22.

(*f*) No low-temperature impact tests are required for any of these materials nor for any deposited weld metal the com-

TABLE 1 MAXIMUM ALLOWABLE DESIGN STRESSES FOR NICKEL AND NICKEL ALLOYS

Material and Spec. Number	Condition	Room Temperature[a]: Min. Spec. Tensile Strength psi	Room Temperature[a]: Min. Spec. Yield Strength (0.2% Offset) psi	Maximum allowable design stress, psi, for metal temperatures not exceeding deg F[b]: Subzero to 150	250	300	350
NICKEL							
Bar, Rod, Shapes							
SB-160	Hot Rolled or Cold Drawn-Annealed	55,000	15,000	10,000	10,000	10,000	10,000
SB-160	Hot Rolled—As Rolled	60,000	15,000	10,000	10,000	10,000	10,000
Pipe or Tube							
SB-161	Cold Drawn—Annealed	55,000	15,000	10,000	10,000	10,000	10,000
SB-161	Cold Drawn—Stress Relieved	65,000	30,000	16,250	16,250	16,250	16,250
SB-161	Cold Drawn—Stress Equalized	70,000	50,000	17,500	17,500	17,500	17,500
Pipe or Tube							
SB-163	Cold Drawn—Annealed	55,000	15,000	10,000	10,000	10,000	10,000
SB-163	Cold Drawn—Stress Relieved	65,000	30,000	16,250	16,250	16,250	16,250
Plate, Sheet, or Strip							
SB-162	Hot or Cold Rolled—Annealed	55,000	15,000	10,000	10,000	10,000	10,000
SB-162	Hot Rolled—As Rolled	60,000	25,000	15,000	15,000	15,000	15,000
NICKEL-COPPER							
Rod, Bar, Shapes							
SB-164[d]	Hot Rolled or Cold Drawn-Annealed	70,000	25,000	16,666	16,666	16,666	16,666
SB-164[e]	Hot Rolled—As Rolled	80,000	40,000	20,000	20,000	20,000	20,000
Pipe or Tube							
SB-165	Cold Drawn—Annealed	70,000	28,000	17,500	17,500	17,500	17,500
SB-165	Cold Drawn—Stress Relieved	85,000	55,000	21,250	21,250	21,250	21,250
SB-165	Cold Drawn—Stress Equalized	85,000	65,000	21,250	21,250	21,250	21,250
Pipe or Tube							
SB-163	Cold Drawn—Annealed	70,000	28,000	17,500	17,500	17,500	17,500
SB-163	Cold Drawn—Stress Relieved	85,000	55,000	21,250	21,250	21,250	21,250
Plate, Sheet, or Strip							
SB-127	Hot or Cold Rolled—Annealed	70,000	28,000	17,500	17,500	17,500	17,500
SB-127	Hot Rolled—As Rolled	75,000	40,000	18,750	18,750	18,750	18,750
NI-CR-FE							
Rod, Bar, Shapes							
SB-166	Hot Rolled or Cold Drawn-Annealed	80,000	30,000	20,000	20,000	20,000	20,000
SB-166	Hot Rolled—As Rolled	85,000	35,000	21,250	21,250	21,250	21,250
Pipe or Tube							
SB-167	Cold Drawn—Annealed	80,000	30,000	20,000	20,000	20,000	20,000
Pipe or Tube							
SB-163	Cold Drawn—Annealed	80,000	30,000	20,000	20,000	20,000	20,000
Plate, Sheet, Strip							
SB-168	Hot or Cold Rolled—Annealed	80,000	30,000	20,000	20,000	20,000	20,000
SB-168	Hot Rolled—As Rolled	85,000	35,000	21,250	21,250	21,250	21,250

Material and Spec. Number	Maximum allowable design stress, psi, for metal at temperatures not exceeding deg F[b]: 400	450	500	550	600	700	800	900	1000	1100	1200
NICKEL											
SB-160	10,000	10,000	10,000	10,000	10,000	...	...	...	...	...	...
SB-160	10,000	10,000	10,000	10,000	10,000	...	...	...	...	...	...
SB-161	10,000	10,000	10,000	10,000	10,000	...	...	...	...	...	...
SB-161	16,250	16,250	16,250	16,250	16,250	...	...	...	...	...	...
SB-161	17,500	17,500	17,500	17,500	17,500	...	...	...	...	...	...
SB-163	10,000	10,000	10,000	10,000	10,000	...	...	...	...	...	...
SB-163	16,250	16,250	16,250	16,250	16,250	...	...	...	...	...	...
SB-162	10,000	10,000	10,000	10,000	10,000	...	...	...	...	...	...
SB-162	15,000	15,000	15,000	15,000	15,000	...	...	...	...	...	...
NICKEL-COPPER											
SB-164[d]	16,666	16,666	16,666	16,666	16,600	16,400	12,000	6,400	...	...	...
SB-164[e]	20,000	20,000	20,000	20,000	20,000	16,000	11,600	3,200	...	...	...
SB-165	17,500	17,500	17,500	17,500	17,500	16,400	12,000	6,400	...	...	...
SB-165	21,250	21,250	21,250	21,250	21,250	16,000[c]	11,600[c]	3,200[c]	...	...	...
SB-165	21,250	21,250	21,250	21,250	21,250	...	...	...	...	...	...
SB-163	17,500	17,500	17,500	17,500	17,500	16,400	12,000	6,400	...	...	...
SB-163	21,250	21,250	21,250	21,250	21,250	16,000[c]	11,600[c]	3,200[c]	...	...	...
SB-127	17,500	17,500	17,500	17,500	17,500	16,400	12,000	6,400	...	...	...
SB-127	18,750	18,750	18,750	18,750	18,750	16,000	11,600	3,200	...	...	...
NI-CR-FE											
SB-166	20,000	20,000	20,000	20,000	20,000	20,000	20,000	12,800	5,600	2,400	800
SB-166	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	11,600	5,760	4,400
SB-167	20,000	20,000	20,000	20,000	20,000	20,000	20,000	12,800	5,600	2,400	800
SB-163	20,000	20,000	20,000	20,000	20,000	20,000	20,000	12,800	5,600	2,400	800
SB-168	20,000	20,000	20,000	20,000	20,000	20,000	20,000	12,800	5,600	2,400	800
SB-168	21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250	11,600	5,760	4,400

NOTES: *a* Room Temperature Tensile Strength and Room Temperature Yield Strength (0.2 per cent offset) values are those being proposed for the latest revision of the A.S.T.M. Specification.

b Design Stress values were based on the following: 1 Test pressure to be $1^1/_2$ times the working pressure.
2 Use values of $^1/_4$ of the tensile or $^2/_3$ the yield strength at 0.2 per cent offset, whichever is the lower, except for elevated temperatures.
3 At elevated temperatures, use 80 per cent of 0.1 CRU creep strength or values at room temperature, whichever is the lower.

c No data available on creep values of stress relieved and stress equalized conditions. Values shown are from annealed or not rolled conditions, whichever is the lower. *d* Class A and Class B. *e* Class A only.

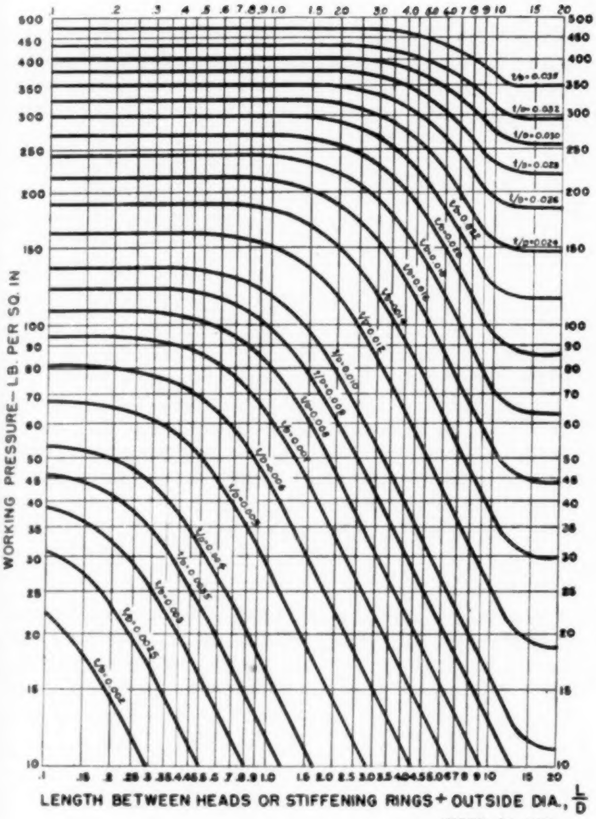


CHART FOR DETERMINING SHELL THICKNESS OF UNFIRED CYLINDRICAL VESSELS SUBJECTED TO EXTERNAL PRESSURE, WHEN CONSTRUCTED OF HOT-ROLLED "B" MONEL PLATE, SB-127

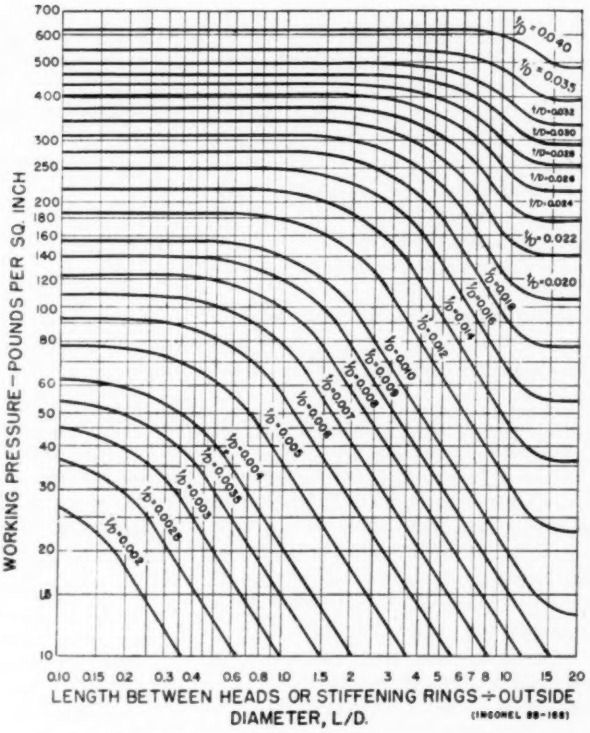


CHART FOR DETERMINING SHELL THICKNESS OF UNFIRED CYLINDRICAL VESSELS SUBJECTED TO EXTERNAL PRESSURE, WHEN CONSTRUCTED OF INCONEL PLATE, SB-168

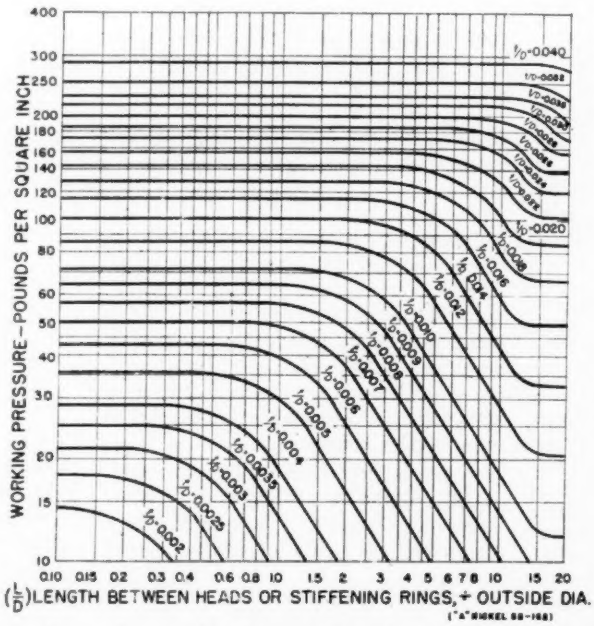


CHART FOR DETERMINING SHELL THICKNESS OF UNFIRED CYLINDRICAL VESSELS SUBJECTED TO EXTERNAL PRESSURE, WHEN CONSTRUCTED OF "A" NICKEL PLATE, SB-162

FIG. U-22

position of which is within the range of composition of the specifications permitted for use under Par. (2) for use at —310 F temperature or above. If the deposited weld metal does not meet this requirement, impact tests of the weld metal shall be made in accordance with the requirements of Par. U-142. If the impact specimen bends, without fracture, it shall be considered to have met the requirements.

(4) *Welding*. The welding requirements of Pars. U-68 and U-69 and Section IX of the Code shall apply except that:

(*a*) The elongation as determined on a transverse weld specimen, or preferably on a longitudinal weld specimen (weld central and parallel to the long side of the specimen) shall be in accordance with Section IX except that the requirements for nickel welds shall be reduced to 25 per cent elongation whether stress relieved or not stress relieved.

Bending may be accomplished by the free-bend method or by the standard jig bend fixture and subsequently flattened until the required elongation is obtained or until failure occurs.

(*b*) All-weld metal tensile specimens are not required.

(5) *Stress-Relieving*. Par. U-68 Construction. No stress-relieving required on welded vessels of nickel, nickel-copper or nickel-chromium-iron alloys up to $^3/_4$ in. thick. Stress-relieving required on material $^3/_4$ in. and heavier.

Par. U-69 Construction. The requirements of Par. U-69 shall be followed for vessels constructed of nickel, nickel-copper, and nickel-chromium-iron.

Where stress-relieving is required by the Code or because of stabilization requirements prior to machining, or other reasons, the procedure of Par. U-76 shall be followed.

Stress-relieving of nickel, nickel-copper, and nickel-chromium-iron alloys is not normally necessary or desirable in the thicknesses encountered in fabrication to date. Because of the lack of information on this subject relative to heavier gage construction, the foregoing limits are set until such time as evidence for the thicker gages can be developed.

The susceptibility of these materials to sulphur embrittlement at elevated temperatures should be borne in mind when stress-relieving. Sulphur-containing materials such as drawing lubricants and compounds, grease, oil, marking paints, etc., should be removed prior to any heating operation. The vessels should be clean. The furnace atmosphere should be low in sulphur content. Coal, coke, and charcoal amost always contain too much sulphur to be useful. Natural or manufactured gas is satisfactory if the sulphur content is less than 30 grains per 100 cu ft. Fuel oil is satisfactory if the sulphur content is less than 0.5 per cent.

(6) *Cutting*. These materials shall not be cut or gouged by the oxyacetylene powder-cutting or oxygen-arc processes in construction unless all metal affected by the cutting can be subsequently removed by grinding or machining.

CASE No. 1084

(*In the hands of the Committee*)

CASE No. 1085

Inquiry: May fusion welding be used for the attachment of staybolts, in lieu of threading or riveting, in the construction of unfired pressure vessels based on the requirements in Par. P-200(c)?

Reply: It is the opinion of the Committee that welded-in staybolts may be used in the construction of unfired pressure vessels in accordance with the following requirements:

(1) The arrangement shall conform to one of these illustrated in Fig. U-6.

(2) With the exception of the requirements which shall be followed when the construction shown in Fig. U-6(c) and (d) are used, the area of each attaching weld in shear shall be not less than 1.25 times the required cross sectional area of the stay, but in no case shall the size of the weld be less than $^3/_8$ in.

(3) The provisions of Paragraphs U-40 and U-44 shall be followed, using the constants for threaded staybolts.

(4) The stress in the staybolts shall not exceed 7500 psi unless the length exceeds 20 diameters, in which case other stress allowances as given in Table U-6 may be used.

(5) The finished construction shall be subject to the same stress-relieving requirements as other welded construction.

CASE No. 1086

Inquiry: Under Par. P-109(a), which under specified conditions requires a hydrostatic test pressure of twice the maximum allowable working pressure, there seems to be some misunderstanding as to whether the hydrostatic test pressure is based on the actual material thickness rather than its design or calculated thickness. Please clarify.

Reply: It is the opinion of the Committee that under Par. P-109(a) the hydrostatic test pressure shall be determined by the design or calculated material thickness.

CASE No. 1087

Inquiry: In view of the urgent need, and published revisions of Par. P-109(a) and related paragraphs in the October issue of MECHANICAL ENGINEERING, that it is the intent to provide that all fusion-welded drums and other fusion welded pressure parts shall be subjected to a hydrostatic test pressure of not less than 1.5 times the maximum allowable working pressure, may these provisions now be used?

Reply: Since there have been no adverse criticisms of the proposed revision mentioned, it is the opinion of the committee that the following revisions of Pars. P-109(a), P-113, and P-112(c), covering the hydrostatic tests of boiler parts meet the intent of the Code and may now be used.

PAR. P-109(a). Revise as follows:

(a) All fusion welded drums and other fusion welded pressure parts shall be subjected to a hydrostatic test pressure of not less than 1.5 times the maximum allowable working pressure.

PAR. P-113. Delete the last sentence of the paragraph beginning with "A hydrostatic test shall be made at twice . . . ."

PAR. P-112(c). Delete the following: "Piping fabricated in accordance with this paragraph shall be subjected to a hydrostatic test of not less than $1^1/_2$ times the maximum allowable working pressure." Par. P-329 as recommended above would cover this.

CASE No. 1088

Inquiry: The revision of Specification SA-157 eliminates Grade C3. What are the maximum allowable stresses which should be used for Grades 3CA and 3CB, which replace it?

Reply: It is the opinion of the Committee that the maximum allowable stresses to be used for Grades 3CA and 3CB of Specification SA-157 are:

Temp deg F	Grade C3A	Grade C3B
—20 to 650	15,000	15,000
700	15,000	15,000
750	15,000	15,000
800	14,000	14,000
850	13,400	12,500
900	11,000	8,800
950	8,250	6,000
1000	5,850	4,200
1050	3,850	3,000
1100	2,200	2,000
1150	1,400	1,400
1200	900	900

CASE No. 1089

Inquiry: When burning solid fuel, Par. P-315 requires that at least one of the feed pumps be steam driven. Where spreader-type stokers are used and only a thin fuel bed normally would remain at the time of cutting off the fuel, may this type of firing be considered the same as pulverized coal firing for this purpose?

Reply: It is the opinion of the Committee that boilers fired with spreader-type stokers may be considered the same as those burning pulverized coal under Par. P-318.

THE ENGINEERING PROFESSION

News and Notes

AS COMPILED AND EDITED BY A. F. BOCHENEK

EJC Labor Legislation Panel Appears Before U. S. Senate Committee

THE Labor Legislation Panel of the Engineers Joint Council appeared before the hearing of the Senate Committee on Labor and Public Affairs held in Washington, D. C., recently to urge retention of the Taft-Hartley definition of professional employees and provisions distinguishing them from nonprofessional employees.

Pointing out that the present law for the first time defines professional employees and gives them statutory protection instead of making them subject to National Labor Relations Board interpretations, as was the case under the Wagner Act, the EJC panel told the Senators: "There has been a distinct trend away from earlier unsatisfactory conditions and we are well on the way toward complete abolishment of the confusion and distress that existed among professional employees under the earlier law."

Panel Represents Seven Societies

The panel was sponsored by Engineers Joint Council, made up of the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers, and included representatives of two other engineering organizations, the American Society for Engineering Education and the National Society of Professional Engineers. E. Lawrence Chandler, assistant secretary ASCE, made the presentation as chairman of the EJC panel.

ASME representation on the EJC panel is W. F. Ryan, Fellow ASME, engineering manager, Stone and Webster Engineering Corporation, Boston, Mass.

Citing cases decided both under the Wagner Act and the Taft-Hartley Law, Mr. Chandler declared:

"A fundamental difficulty with the Wagner Act, as it affected professional employees, was that no distinction was made between professional and nonprofessional employees in spite of the facts that their viewpoints and abilities are inherently different and that their conditions of employment cannot be made subject to a common standard. There is no yardstick by which creative ability can be measured. To attempt application of the same standard of measurement for services of professional men and nonprofessional men is not in the public interest. The output of professional employees cannot be standardized as can that of manual and skilled labor. It cannot be measured in terms such as the number of bricks a man should lay in a given number of hours, the number of cubic yards of dirt that should be moved, the square yards of painting, the amount of type to be set, feet of conduit to be laid, or in terms of any other similar unit.

Wagner Act Unsatisfactory

"In spite of all this, prior to enactment of the present law, professional employees often were included against their will in heterogeneous groups and compelled to accept representation which they did not desire in collective bargaining procedure. The results were most unsatisfactory. There was serious effect on the morale of professional employees and generally poor relationships developed between those employees and labor unions and employers. Even though the vote of the professional employees were unanimous against proposed representation, it was of no avail. By sheer numerical force the professional employees were denied effective representation."

Starting Salaries

STARTING salaries for graduates of the New York University College of Engineering increased in 1948 by 11 per cent over the previous year, according to the results of a recent survey in which 365 graduates were asked the nature of the position they held, how it was obtained, and the starting salary.

The average starting salary, it was revealed, was $252 a month, an increase of $25 over the 1947 average. The largest starting-salary increase, 16 per cent, appeared to be in the aeronautical and administrative engineering fields, the survey reported.

Of the 177 graduates who returned their questionnaires, 72 per cent took jobs in private industry, 16 per cent went into civil-service posts, 9 per cent enrolled for graduate courses, and 3 per cent were classified as miscellaneous.

In answer to the question, "How did you find your job?" 24 per cent of the responding students listed the University's placement bureau; 11 per cent, the college of engineering faculty; 26 per cent, personal inquiry; 15 per cent, family and friends; and 24 per cent, newspaper, agency, or engineering societies.

Wartime Use of Scientific Man Power

A STUDY of the military use of thousands of scientists and engineers during World War II has just been completed, the Department of the Army announced recently. The study revealed serious shortcomings in previous procedures. It provides a basis for future planning in order that maximum application of science and scientists to national defense may be assured during any future emergency.

The case histories of 15,157 scientists and engineers including members of The American Society of Mechanical Engineers who were in the Armed Forces during the last war have been analyzed and tabulated in a report which is based on a survey made with the co-operation of societies representing the nine major scientific fields of biology, chemistry, civil engineering, mechanical engineering, geography, geology, mathematics, physics, and psychology.

30 Per Cent Utilization Reported

During World War II, only 30 per cent of the scientists included in the study indicated that their specialized abilities were utilized throughout most of their war service at a level of technical responsibility commensurate with their past training and experience. An additional 15 per cent reported that their scientific skills were used about half of the time and 18 per cent said that a reasonably satisfactory utilization was made of their general technical background, rather than of their primary field. The remaining 37 per cent reported that little or no use was made of either their special scientific experience and training, or their general technical background.

As a result, the report points out, if the scientists and engineers were not well utilized it is probable that we did not effectively use the technical knowledge which was available in the United States.

The method of entry into the Armed Forces had a direct bearing on the utilization of scientific skills, the report indicated. Only 52 per cent of the scientists who were drafted reported that their technical skills were well used. By contrast, more than three fourths of the scientists commissioned direct from civilian life stated that their skills were satisfactorily utilized. Among those who held Reserve commissions prior to the war, 64 per cent were in this category. Scientists who voluntarily enlisted were almost as poorly utilized technically as those who were drafted.

Many outstanding American scientists, in

reporting their own military experiences, commented that the assignment of scientists under the Selective Service System was wasteful of scientific man power because of the absence of scientific selective procedures. An undesirable onus, they indicated according to the report, was placed on the individual who was deferred from military service for important research and development work in a civilian capacity because the concept of scientific selectivity was not understood or popularly accepted. They also pointed out that professional scientists were not utilized effectively at the enlisted level in the Armed Forces and that the prewar Organized Reserve Program had failed to allocate scientists holding Reserve commissions to appropriate military activities. In addition, many scientists pointed to the lack of proper planning liaison between the scientific world and military planners.

Military assignments were too often influenced by physical fitness, the report also revealed, which prevented the commissioning and effective technical utilization of many scientists with minor physical disabilities who were fully capable of performing specialized noncombat duties.

In order to plan realistically for the future, the report recommends the establishment of a national office which will evaluate the present and potential supply of scientific man power in terms of the nation's present and potential requirements. Because of their familiarity with the personnel in their respective fields, the report stated, the various national scientific and engineering societies appear to be the logical agents for the task of cataloguing and evaluating our scientific man-power supply in the same way as we plan for the use of industrial facilities.

Inadequacy of Regulations

The inadequacy of man-power regulations utilized during World War II, in so far as scientists were concerned, is also brought out in the report. It indicates particularly the need for procedures both on a national scale and within the Armed Services which will make it possible to use all scientists effectively in any future war. In order to accomplish this, the report recommends that policies and procedures be established which will lead to an equitable national allocation of scientific man power in any future emergency according to need. In discussing the national activities which will require the services of scientists, the following six major points were listed:

1 The military services must be supplied with an adequate number of professional scientists and engineers, both civilian and uniformed, to perform their technical missions.

2 Adequate numbers of physicians and supporting personnel such as radiologists, bacteriologists, and sanitary engineers must be reserved in civilian status to maintain the national health.

3 A sufficient number of civilian engineers and scientists must be assigned to operate communication and transportation systems and light-and-heat facilities.

4 Industry must utilize scientific man power to carry on research, development, testing, and production to support the war effort and the civilian economy.

5 Various nonmilitary governmental agencies must continue their scientific activities.

6 Educational activities must be continued on a reduced but significant scale so that we do not sacrifice the long-range welfare of the country to short-range needs.

Partners in Production

BASIC objectives of both labor and management can be reduced to about four fundamental goals on each side, according to a new report, "Partners in Production: A Basis for Labor-Management Understanding," soon to be issued by the Labor Committee of the Twentieth Century Fund. The road to industrial peace lies through mutual understanding of these goals, according to the report.

The Twentieth Century Fund is a foundation for scientific research and public education on current economic problems, founded in 1919 and endowed by the late Edward A. Filene. The Fund's income, administered as a public trust by a board of trustees, is devoted entirely to its own activities.

Goals of Labor and Management

The Committee, which included employers, officials of both AFL and CIO, economists, and former government administrators, lists the four fundamental goals of labor as:

1 A sense of security, both on the job and in the community. The organized worker looks upon the union as his primary safeguard.

2 An opportunity to advance, a fair chance for promotion, and general betterment.

3 More human treatment, including being consulted about things that vitally affect labor's welfare.

4 A sense of dignity on the job, a feeling of doing useful, constructive work.

The Committee states the four fundamental goals of management as:

1 Good business for the company and its general economic health.

2 Good relations with its own employees, to gain their loyalty and keep them satisfied with working conditions.

3 Freedom to manage, without interference from unions or employees.

4 Businesslike relationships and more responsibility on the part of employees and unions, so that the company will have assurance that contracts and agreements will be carried out.

Management's Attitudes

The Committee considers the attitudes of the other side to each set of goals. In setting forth general attitudes of management on labor's first goal of security, the Committee says: "Management's quarrel with labor over the question of security is one of emphasis. Management believes that the emphasis should be placed on the profitable and efficient output of goods and that security for the workers is a necessary by-product—nevertheless, by-product."

On the worker's basic feeling of security or insecurity, outside the plant as well as in it, the Committee says: "Management is becoming increasingly aware that the worker's sense of insecurity does not derive solely from the more obvious threat to job tenure but has other causes, such as social disorganization in the plant and in the community..... Progressive employers, for instance, have abandoned the old idea that the company's interest always lies in keeping down the tax rate. They have learned that secure citizens outside the plant make more stable employees and they are willing to pay higher taxes in order to get a good public school system."

Of management's attitude toward labor's goal of a chance to advance, the Committee points out that: "Management feels frustrated in its attempts to harness the personal ambitions of workers to production. The top ranks of industry .... find it difficult to understand either the disrepute in which the self-made hero is currently held in working circles or why the employees, through their unions, will voluntarily set up seniority barriers that block their own chances to get ahead."

On labor's desire for more human treatment, the Fund's Committee observes that: "Management agrees with labor that far more emphasis should be placed on the worker's human problems on the job..... Though management is making progress on this score, it is inclined to think that labor fails to appreciate the size of the task, which is to devise ways of giving as warm individualized treatment to thousands of employees as the old-time boss used to be able to hand out to his ten or twenty helpers."

Regarding labor's desire for more dignity, the Committee says: "Here again progressive management agrees with labor that more dignity must be given to the job. Again, management feels it is easier to see this goal than to find the way toward its attainment."

Labor's Attitudes

Turning to the other side to examine labor's attitudes on the goals of management, the Committee finds that labor has no real quarrel with the primary goal of the economic welfare of the company. "Labor is just as interested as management in a prosperous business community, the source of the jobs and incomes of its members. It may disagree with management about the method of reaching that goal in particular companies, but the goal is the same. When labor espouses high wages in order to increase purchasing power, it does so for the sake of the same prosperity that employers are after when they champion high profits to keep the economy dynamic and expanding."

About management's desire for good relations with its own employees, the Fund's Committee says: "Labor thinks that, if employers would really accept unionism and then make efforts to understand the union's needs, instead of continually doing things, often out of ignorance, that undermine it,

both the union and management could work jointly for the benefit of the employees. Under such circumstances, it says, the conflict between the two for the worker's loyalty would vanish. It points to scores of examples where labor and management are co-operating and the worker is loyal to both."

Labor recognizes management's desire and need for freedom to manage, says the Committee. "Unions can play a useful role, they feel, in actually increasing management's authority by acting as an effective communications link in advance of change and thereby increasing the willingness of the men to accept that change."

On the desire for more responsibility on the part of employees, the Fund's Committee says: "Labor answers management's charge that it is unbusinesslike and irresponsible by saying: (1) Maturity brings responsibility and many unions are still young; and (2) labor unions are political institutions and employers should face this reality and make allowance for it. Maturity, labor says, takes time and a co-operative, understanding management. Unions believe that management usually has only itself to blame for an irresponsible union, that it gets just about the type of union official it deserves. With this sentiment many employers agree."

Howard Coonley, Assoc. ASME, chairman in 1948 of the Board on Codes and Standards of The American Society of Mechanical Engineers, is one of the members of the Fund's Labor Committee.

Engineers to Help Pioneer New Industries

NOT television, not nuclear energy, but developments in the field of heavy chemicals will provide the country with the next economically important "great new industry" according to James M. Todd, president of The American Society of Mechanical Engineers, who spoke recently before the Round Table Club of New Orleans, La.

When the new industry emerges, "engineers will be in the midst of it, responsible for its growth and quite possibly for its inception." He said such a role is but one aspect of a traditional activity of engineers: operating, maintaining, and extending the material basis of civilization.

To fulfill this role the nation is graduating at least three times as many engineers as are needed in the technical phases of the profession, and by far the greater part of these extra engineers are going into industry as part of management, said Mr. Todd.

He added that we ought to be turning out eight or ten "management men" for every strictly technical man, to staff industry's personnel, sales, and production departments.

"Distinctively, many men with engineering training are production men," he declared. "Their work is in factories, large and small. They lay out plants and assembly lines. They plan production methods and scheduling. They arrange for the smooth flow of materials into, through, and out of the factory. They watch for and strive to eliminate bottlenecks. "They improve old ways of doing things and experiment with new ways, such as the fabrication of machine frames by welding instead of casting. They use job-simplification techniques, sometimes called motion-study, to lessen fatigue and increase production. Often one finds them in the direct line of command of the production force."

ASEE Summer School Planned for June 25–July 1

THE 1949 Summer School for Mechanical-Engineering Teachers sponsored by the Mechanical Engineering Division of the American Society for Engineering Education in co-operation with The American Society of Mechanical Engineers will be held on the campus of Rensselaer Polytechnic Institute, Troy, N. Y., June 25–July 1, 1949. The summer school will follow the 1949 annual meeting of the ASEE planned for June 20–24, 1949.

The summer-school program emphasizes the teaching aspects of mechanical-engineering subjects and includes materials which will be helpful to the instructor in planning for his professional development. Subjects to be covered include: Teaching methods; professional development of the instructor; presentation of subject matter for general and specialized mechanical-engineering courses; integration of the curriculum; professional development of the student; and preparation of the student for his first job.

The ASEE Mechanical Division's sessions during the ASEE annual meeting are scheduled for the two days preceding the summer school. Those who plan to attend both the summer school and the annual meeting are urged to make reservations as early as possible in order to be housed in the building which will be used by the summer school. Late registration will probably mean a change to another dormitory at the close of the annual meeting.

Preliminary estimates by R.P.I. indicate that the cost of room and meals will probably be less than $40 per person for the week.

A feature of the summer school will be a Recognition Dinner on Friday, June 24, during which the ASEE Mechanical Engineering Division will honor eminent teachers for their contributions to engineering teachers and to the engineering profession in general. On the following day two sessions have been scheduled to give Old-Timers an opportunity to discuss subjects of interest to young instructors.

The summer-school program will consist of 15 two and three-hour sessions dealing with a broad list of matters pertaining to engineering education. List of speakers will be published in a later issue of MECHANICAL ENGINEERING.,

Frank Martinuzzi Reviews European Gas-Turbine Activity

MEMBERS of the Gas Turbine Division of The American Society of Mechanical Engineers heard an authoritative report of current European activity in the field of industrial gas turbines recently from Frank Martinuzzi, Mem. ASME, on his return to this country to accept a post as professor of heat-power engineering at Cornell University, Ithaca, N. Y.

Honored at Dinner

W. Julian King, Mem. ASME, and director of the school of mechanical engineering, Cornell University, presided at the meeting held Feb. 2, 1949, at the Engineering Societies Building, New York, N. Y. The meeting preceded a dinner given for Dr. Martinuzzi. Mr. King recalled that American engineers were indebted to Theodor von Kármán, Mem. ASME, for calling attention of the Society to Dr. Martinuzzi's work in Italy. Dr. Martinuzzi was named the 1948 Calvin Rice lecturer following his address at the 1948 Semi-Annual Meeting where he presented a comparison between American and European gas-turbine and compressor calculation methods.

After his return to Europe last summer, Dr. Martinuzzi visited the major gas-turbine centers on the continent and in England, and is perhaps the best-informed engineer on the trends and the current state of the art, Mr. King said. His great personal charm and disarming candor and prudence have won for him the friendship and confidence of the world's leading designers.

In his report of his observations and conversations in Europe, Dr. Martinuzzi limited himself to a review of developments since July, 1948.

In his own country, Italy, Dr. Martinuzzi said that while little progress had been made in the past, major engineering companies have recently taken steps to organize a new corporation to build gas turbines under joint sponsorship. Conditions were favorable for such a development because Italy was the only country in Europe which had idle engineering talent and manufacturing facilities. Italian interest, he said, may be expected to concentrate on naval and industrial gas turbines to the exclusion of aviation units.

Swiss Activity Reported

In Switzerland, Dr. Martinuzzi reported that the Brown Boveri 13,000-kw open-cycle unit at Beznau had been running constantly all winter because of the severe drought in the country. Considerable operating experience has been accumulated and should be reported in the literature soon. Commenting on the 27,000-kw Beznau unit now in the assembly stage, Dr. Martinuzzi described its tremendous physical size and reported the opinion of Swiss engineers that 27,000 kw appeared to be the practical maximum limit for open-cycle gas turbines.

Although Swiss interest in the coal-burning gas turbine was at a low ebb, he said, many engineers there feel that a unit using a gas producer rather than a combustor burning pulverized coal, had some chance for success. For optimum efficiency, however, Swiss engineers are placing their money on a steam and gas-tur-

bine combination unit, and are looking for customers for such a unit. Interest in the comprex was much in evidence.

In France, Dr. Martinuzzi reported, gas-turbine activity is marked chiefly by French confidence, as exemplified by a proposed installation of a 3500-kw unit in a single screw seagoing vessel.

In England, Dr. Martinuzzi was impressed by the intense national activity in the gas-turbine field and the pooling of design talent and information to develop a lead in the industrial gas-turbine field similar to the one the country now enjoys in the aviation field.

Anniversary Volume Honors Hans J. Reissner

AT a surprise dinner held recently in New York, N. Y., and attended by leading scientists and engineers working in applied mechanics and aeronautical engineering, on the occasion of his 75th birthday, Hans J. Reissner, one of the pioneers of aeronautical engineering, was presented with the first copy of the Reissner Anniversary Volume published by his colleagues as a tribute to him as a scientist and teacher.

The volume contained articles by 32 American and European authorities on such subjects as aerodynamics, elasticity and structures, electricity, mathematical methods, plasticity, and propulsion. These are the fields in which at one time or another Dr. Reissner has been active.

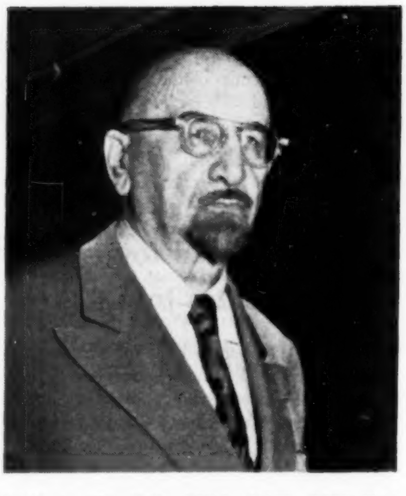
Dr. Reissner is a member of The American Society of Mechanical Engineers and professor of aeronautics and aerostructures, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Other scientists in this country who have been similarly honored are Theodor von Kármán, Mem. ASME, head of the Guggenheim School of Aeronautics, California Institute of Technology, Pasadena, Calif.; Stephen Timoshenko, Fellow ASME, professor emeritus of theoretical and applied mechanics, Stanford University, Stanford, Calif.; and Richard Courant, head of the Institute of Mathematics and Mechanics, New York University, New York, N. Y.

Dr. Reissner, who is credited with the design of the first successful all-metal airplane and the first controllable-pitch propeller, was born in Berlin, Germany, in 1874. He received his formal engineering education at the Polytechnic Institute of Berlin. After some years of engineering practice in Germany with the Rhine Waterways Department and as consultant with the Zeppelin Company, Dr. Reissner was appointed a full professor of the Polytechnic Institute of Aachen in 1906, and has continued his career as a teacher ever since.

In 1936 when the principles and ideals for which the Germany of his youth had stood were discarded and ridiculed by the Nazis, Dr. Reissner came to this country to become research professor of engineering at the Armour Institute, Illinois Institute of Technology. He joined the staff of the Polytechnic Institute of Brooklyn in 1943.

For the past several years Dr. Reissner has worked in the field of supersonic aeronautics. One of his current projects is to determine



HANS J. REISSNER, MEM. ASME, WHO WAS RECENTLY HONORED BY PUBLICATION OF A REISSNER ANNIVERSARY VOLUME

mathematically what occurs inside shock waves. These waves of compressed air form on the leading edges of airplane component parts whenever the aircraft flies near or above the speed of sound. Inside the shock waves which are about one hundred thousandth of an inch thick, energy is severely wasted, energy which otherwise would be available for propelling the aircraft. This work, conducted for the Office of Naval Research and the National Advisory Committee for Aeronautics, has already produced important results.

New Developments Reported at 1949 AIEE Winter Meeting

A NEW method of cooling large electric machines reported to be as revolutionary as hydrogen cooling in the 1920's, was one of many new developments reported at the 1949 winter meeting of the American Institute of Electrical Engineers held at the Hotel Statler, New York, N. Y., Jan. 31–Feb. 4, 1949.

Considerable savings as well as other advantages are expected from the new process, according to Th. de Koning, of Drexel Hill, Pa., who described the method in a paper, "Vaporization Cooling of Large Electric Machines." The principles of vaporization cooling are totally different from those customarily associated with air, hydrogen, and fluid cooling, he said. The method offers a standard universal solution, feasible for the cooling of large machines of all types. Water in mist form is supplied to the natural surfaces.

Among the advantages of the proposed vaporization cooling system over the present cooling systems were: A saving of 5 to 15 per cent in copper and punching volume, a slightly better efficiency, improved simplicity, a saving of 25 per cent and more in weight, and a saving of 15 per cent in cost of large machines.

Ultra-High-Speed Shutter

Another development reported was that of an ultra-high-speed electrical camera shutter with no moving parts, that opens new research areas in detonation phenomena, ballistics, electrical discharges, the action of fuses, arc phenomena, and many other fields.

The new shutter is an adaptation of the phenomenon of electrical refraction discovered by J. Kerr in 1875 and applied to a light valve called a Kerr cell shutter, which is used for the measurement of very small time intervals. Two plates, or electrodes, are immersed in a fluid that becomes transparent when an electric current is passed through it. The length of the exposure is regulated by the voltages applied.

The authors reported that "with the aid of such a shutter, routine photographic studies of electric discharges have been made at exposures of 0.00000004 second."

Infrared Detector

One author described how the infrared detector or bolometer, a device used in war by the Germans to accurately track the course of ships through the English Channel, has been adapted to peacetime use for locating faults on power-transmission lines.

The detector consists of two parts—a parabolic mirror which collects the heat radiation from the transmission-line joint being tested, and a heat-sensitive element mounted at the focus of the mirror.

Better Television

Reporting on research into "Brightness and Contrast in Television," P. C. Goldmark of the Columbia Broadcasting Studios said, "Contrast range is more important than mere brilliance, and contrast at moderate brightness is far more important to the eye than brightness applied indiscriminately. Increased brightness is of use to the eye only if it brings with it increased contrast.

"It is this increased contrast which assists the eye to see fine detail. If one wishes to see greater detail in a picture, one may increase the contrast, if possible, or move closer to it for a more detailed examination. The limit is set by the maximum possible picture brightness and then by the resolving power of the eye."

FPRS Membership Nearly Doubled in 1948

THE Forest Products Research Society, organized two years ago to promote more efficient use of wood and other forest products, entered its third year with an active membership of 1850.

Industries represented among its membership include logging and sawmilling, furniture, pulp and paper, containers, plywood and veneers, equipment manufacturers, wholesale lumber dealers, importers, educational institutions, commercial laboratories, state and federal laboratories, and many others.

The society, whose headquarters is in Madison, Wis., is endeavoring to bring about the greatest possible interchange of information among all persons and organizations concerned with forest products.

Broad Program Attracts 2500 Engineers to ASCE 1949 Annual Meeting

INDUSTRIAL pollution in New York State, industrial dispersion for atomic-age safety; construction-engineering education, and air-transport problems were some of the topics discussed by 2500 engineers at the 1949 Annual Meeting of the American Society of Civil Engineers, held at the Commodore Hotel, New York, N. Y., January 12–19, 1949.

With more than a billion gallons of filth flowing untreated into New York watercourses, clean water in the state will soon be only a memory unless some steps are taken to check and eliminate the burden of pollution which now threatens New York's greatest basic resource. According to Harold C. Ostertag, chairman of the New York Joint Legislative Committee on Interstate Co-operation, the cost of water treatment is one which must be assumed by everyone, communities, industries, and individuals.

Industrial Dispersion

Atomic bombing of industrial concentrations of five square miles or less "probably will not be strategically feasible" for any enemy unless the concentrations contain specific installations of decisive importance to the nation's capacity for defense," Dario G. Barozzi, assistant director of industrial dispersion of the National Securities Board, Washington, D. C., told the meeting.

Mr. Barozzi emphasized that reasonable security can be achieved within existing regional frameworks, and, industry-wise, dispersion "must be such that it can be woven into our private enterprise system with minimum difficulty and be economically feasible." Population-wise, he said, dispersion "must be thoroughly consistent with efforts toward better standards of living and working." While suggesting that federal policy "might take the form of providing technical and possibly financial assistance" to state, regional, and local planning commissions, Mr. Barozzi stressed the point that the Security Board's planning for dispersion "involves no mass exodus from our larger metropolitan areas" and that it "can hardly be construed as an effort to stampede American industry and the American people into a hysterical repudiation of our free and easy way of life.

"At this moment, about 60 per cent of our population lives in urban areas which occupy less than 3 per cent of our total land area. This is a good measure of our vulnerability, because these population concentrations are also the concentrations of industry, transportation, business management, and governmental administration. During the period 1940–1948, the population of the United States gained 14.3 million people, but our cities and their suburbs added 10.3 million people or about 72 per cent of the total gain for the country as a whole. By 1975 the Census Bureau forecasts that our population will increase by another 25 to 40 million."

Construction-Engineering Education

Several speakers foresaw lower building cost through support of better construction-engineering training by the construction industry. Such training would eliminate working at cross purposes by contractors' and owners' engineers and thus secure better work at less cost. A designer with a working knowledge of construction methods and costs could be expected to produce more practical and economical designs. Another speaker called attention to the serious lack of suitable textbooks and other teaching aids for most construction courses.

Among the forms of assistance suggested, which the construction industry could provide the schools were financial aid, teaching services of lecturers, course subject matter and teaching aids, construction background and experience on a co-operative basis, and reference publications such as manuals, technical reports, contract documents, and exhibits.

Air Travel

With respect to terminal buildings at airports, civil engineers were urged to concentrate on "what to build rather than how to build it," Thomas M. Sullivan, engineer of airports, Port of New York Authority, said. Most buildings were too small a year after completion. Buildings should be planned for maximum aircraft capacity that the runway configuration will permit. The designs, he said, should be aimed at meeting the needs of the growing number of airline passengers and the number of aircraft that electronic engineers feel may be possible to land and take off on a dual runway in any one peak hour, namely 120 movements per peak hour.

ASME Sponsors Research on Effect of Pressure on Viscosity of Lubricants

TO EXTEND knowledge of the effect of pressure on viscosity of lubricants, The American Society of Mechanical Engineers is sponsoring a research project at the Graduate School of Engineering, Harvard University, Cambridge, Mass. Long active in the solution of fundamental problems of broad industrial interest, the ASME Research Committee on Lubrication recently conducted a correlative study of earlier investigations on this subject and the present research has been planned largely from indications gained from the study.

The first meeting of an Industry Advisory Board, established to guide ASME in the choice of lubricants to be investigated, was held in the Engineering Societies Building, New York, N. Y., Jan. 24, 1949. This meeting resulted in the selection of oils to be investigated in the first part of the program. These will consist of the naphthenic and paraffinic types with samples chosen to provide a wide spread in general characteristics. Also selected were oils with additives such as viscosity-index improvers and pour-point depressants. Each sample will be identified by a series of carefully selected physical tests and by type analysis.

Professor Kleinschmidt to Direct Project

Prof. R. V. Kleinschmidt, director of the project at Harvard University, is no stranger to research of this nature. As early as 1928 in Prof. P. W. Bridgman's laboratory, he recorded the highest published pressure (135,000 psi) in quantitative measurements of viscosity during an investigation conducted for the ASME Research Committee on Lubrication. Presently working with him, on the basis of ASME research fellowships, are M. Mark and D. Bradbury. R. Claflin and F. Lenher, graduate students, are now employed as half-time assistants.

Depending on the characteristics of the oil under test, viscosity measurements for the most part will be made to pressures as high as 150,000 psi at a series of temperatures ranging from 32 F to 425 F. For theoretical reasons, measurements will be made at 450,000 psi on a limited number of oils. The latter will be undertaken using high-pressure techniques recently developed by Professor Bridgman in equipment permitting determination of viscosities of the more fluid lubricants.

Where appropriate, pressure-viscosity curves will be established for several different shear stresses ranging from 0.01 to 40 gram per sq cm.

The program will be co-ordinated with American Petroleum Institute Project 42 at The Pennsylvania State College, State College, Pa. Prof. Wayne Webb of Pennsylvania State College is acting in liaison capacity with the ASME project, while E. M. Barber, chairman of the subcommittee guiding this Society's project, will act in a similar capacity with respect to Project 42. Samples of pure hydrocarbons are being obtained from Project 42 for calibration and comparative purposes. Certain lubricants have also been selected for possible correlation of the pressure-viscosity characteristics with lubrication performance in machine-element tests being conducted by the Co-ordinating Research Council, which is a joint agency of the Society of Automotive Engineers and the API.

Industry Supports Project

Funds totaling over $26,000 for the pressure-viscosity project have been subscribed by a number of companies in the chemical, mechanical, and petroleum industries. In addition, The Engineering Foundation has made a grant of $3000, effective during the fiscal year which started Oct. 1, 1948.

This project well illustrates the utility of the Society's policy of defining problems common to one or more industries and of sponsoring broad investigations for these groups.

1949 Midwest Power Conference Planned for April 19–20

THE eleventh annual Midwest Power Conference will be held April 18–20, 1949, at the Sherman Hotel, Chicago, Ill.

Principal sessions of the conference will be centered about the theme, "How to Better Supply Power Needs in Periods of Declining Resources."

The annual three-day meeting is sponsored by Illinois Institute of Technology with the co-operation of 18 Midwestern universities and professional societies. Each year the conference attracts more than 2500 engineers from all parts of the United States and Canada.

Co-operating institutions are: Iowa State and Michigan State Colleges, Northwestern and Purdue Universities, the Universities of Iowa, Illinois, Michigan, Minnesota, and Wisconsin, Western Society of Engineers, Engineers' Society of Milwaukee, National Association of Power Engineers, the Illinois chapter of American Society of Heating and Ventilating Engineers, the Illinois section of American Society of Civil Engineers, and the Chicago sections of the American Institute of Mining and Metallurgical engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers. Roland A. Budenholzer, Mem. ASME, professor of mechanical engineering at Illinois Tech, was named conference director in September. He replaced Stanton E. Winston, Mem. ASME, director of the conference since 1940, who resigned to devote full time to his duties as dean of the evening division and professor of mechanical engineering at Illinois Institute of Technology.

Director of Research Sought by Army Engineers

THE Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army, Fort Belvoir, Va., is looking for an engineer with at least 15 years' experience in research and development work exclusive of graduate work, to take over a newly created position of director of research and development.

The successful applicant will receive a salary of $12,500 per year and will serve as chairman of the research council, a panel of seven key technical personnel in the Laboratories.

Responsibilities of the position involve direction of the current research and development program in such fields as civil, electrical, and military engineering, physics, and physical and organic chemistry. The director will also be responsible for top-level liaison between other departments of the Armed Forces, private research organizations, and engineering societies.

Applications should be addressed to Col. John C. Arrowsmith, commanding officer at the Laboratories.

Smoke Abatement

THE engineering profession must assume responsibility for air-purification control because industrial communities are currently pressing for cleaner air with the same fervor that they put into demands for pure water and milk, according to H. B. Hammers, director of engineering, Coal Producers Committee for Smoke Abatement, Cincinnati, Ohio. Mr. Hammer spoke before the ASME West Virginia Section of The American Society of Mechanical Engineers.

"Proper educational programs are necessary and should be carried out at the 'plant operation level,'" he said. "This should assist in overcoming the smoke made by carelessness and indifference which is the outstanding obstacle today to correction of the smoke nuisance.

"The haphazard methods and equipment now employed for disposing of waste materials should no longer be tolerated due to the smoke, fumes, and dust that result. Some localities, impatient with the time required to establish basic facts and considerations, have approved smoke laws and regulations predicated mostly on wishful thinking, the hope of quick returns, and with closed minds in respect to scientific and engineering means which should be employed.

"There is no easy road to smoke abatement and air purification," he concluded.

Weapons Systems Evaluation Group Established

APPOINTMENT of Lieut. Gen. John E. Hull, U. S. Army, as director of the Weapons Systems Evaluation Group of the National Military Establishment, was recently announced by Secretary of Defense James Forrestal.

The Weapons Systems Evaluation Group, created recently by Secretary Forrestal after a six months' study by the Joint Chiefs of Staff and the Research and Development Board, will be responsible for the careful evaluation of all present or projected systems of attack and defense. It will be in close touch with the operational research groups serving the more specialized needs of the three military departments, and they will co-operate frequently in carrying out portions of the more general studies of WSEG.

A civilian research director will be appointed later as the chief scientific officer of the Group, and the Group's small staff will include both military officers, and civilian scientists and other experts. The Group's mission is technical and operational evaluation on an interservice basis of present and future weapons and weapons systems under probable future combat conditions, to be prepared by the ablest professional minds, military and civilian, and the most advanced analytical methods that can be brought to bear.

Codes and Standards

New Plumbing Code to Promote Nation-Wide Standardization

PUBLICATION this month of a new American Standard Plumbing Code ASA-A40.7-1949 by The American Society of Mechanical Engineers makes available to the plumbing industry, sanitary engineers, and health and housing administrators a single document which is expected to exert a powerful influence on nation-wide uniformity in plumbing practice and which should stimulate widespread interest in research and development of current plumbing design and installation.

Sponsored by the American Public Health Association and the ASME under procedures of the American Standards Association, the code is the work of 30 national organizations and government bodies working in the field of sanitation and public health.

Minimum Requirements Covered

The 87-page document covers minimum safety and health requirements for design, installation, inspection, and performance of plumbing equipment and systems, including water supply, distribution, drainage, and venting systems. The code does not include dimensional standards, materials specification, or marine installations.

The code is expected to answer the long-felt need for a single recognized standard plumbing code capable of adoption by the states and municipalities. It provides in one document acceptable provisions of codes created since 1924 by such agencies as the U. S. Department of Commerce, National Association of Master Plumbers, and state laws and city ordinances having to do with regulation of design and installation of plumbing equipment. Based on physical laws which are not affected by altitude or climatic conditions, the code can be safely adopted by communities in every region of the nation.

Work on the code began in 1928 when the American Standards Association organized the Sectional Committee on Minimum Requirements for Plumbing and Standardization of Plumbing Equipment. While some progress was made, it was not until the original committee was reorganized in 1941 that work on the draft was begun in earnest.

Adhering to the principle of minimum requirements the committee based its decisions on research and existing data on performances provided by the various co-operating agencies. Where such data were not available, the committee accepted established practice even when these went beyond the requirements

for safety and health. In other instances basic data to which was added a generous factor of safety were used.

Guide to States and Municipalities

The purposes of the code, according to the Committee, "is to present a co-ordinated set of rules which will serve as a guide to state and municipal authorities responsible for the establishment and enforcement of regulations for the installation and maintenance of plumbing and which may be adopted by them in whole or in part." The code "establishes those minimum requirements for plumbing systems necessary to protect the potable water and disposal of water-borne wastes in a manner that will safely provide protection against hazards to health and provide satisfactory performances."

The 13 sections cover: definitions; general regulations; materials, quality, and weight; joints and connections; traps, interceptors, and clean-outs; hangers and supports; plumbing fixtures; water supply and distribution; soil and waste pipe; storm drains; vents and venting; indirect waste and waste pipe; and inspection and tests.

Since the legal aspects of enforcement of plumbing regulations vary extensively throughout the country, rules pertaining to administration of the code are contained in an appendix. This section deals with enforcement, penalties for violation, fees, licensing, bonding, and rules and regulations for administrative authority.

Future Research

In drafting the code the committee selected only those materials, fixtures, and methods which have been proved to be satisfactory by experience or laboratory test. Many new developments had to be omitted because of lack of proof that they were satisfactory on a minimum requirement basis. Aware of the rapid technological advance of the field, the committee is planning to modify the code as experimental and performance data are assemsembled. To provide such data research has been initiated on such problems as: stack and drain capacities under a wide variety of conditions; effects of corrosion and accumulation of grease; discharge characteristics of fixtures where not now available; siphonage of fixture traps; use of welding for water pipes and for drainage systems; and use of plastics and other materials.

Copies of the code may be obtained from ASME Publications Sales Department, 29 West 39th Street, New York 18, N. Y. Price per copy is $2.50.

Classification of 15,000-Kw Preferred Standard Turbine-Generator Unit Changed

EARLY in 1947 the question of changing the classification of the 15,000-kw and 11,500-kw preferred standard turbine-generator units came up for discussion. At a meeting of The American Society of Mechanical Engineers Special Standards Committee on Steam Turbines held in Atlantic City, N. J., during the 1947 Annual Meeting of the Society, it was recommended that the classification of the 15,000-kw unit be changed but that action on the 11,500-kw unit be postponed pending further study.

Unanimous agreement was reached at a meeting in April, 1948, of the special standards committee on the following items: The 15,000-kw standardized machine as now set up in the preferred standard for operation at 600 psig, 825 F, and air-cooled be changed to 850 psig, 900 F, and hydrogen cooled; the turbine to have maximum capability of 16,500 kw. This is to be the new standard without alternate.

The committee also agreed unanimously that the definition of "turbine capability" appearing in the footnote to the table of standards be amended to read "The 'turbine capability' is guaranteed . . . under specified throttle steam pressure and temperature and $2^1/_2$ in. Hg abs exhaust pressure, . . . extraction openings." All manufacturers have designed their standard units to give full turbine capability at $2^1/_2$ in. Hg abs exhaust pressure.

Final approval of this change in the preferred standard was given by the Society through action of its Board on Codes and Standards on Oct. 22, 1948. Similar approval has been given by the American Institute of Electrical Engineers on the recommendation of its Committee on Steam Turbine Generators.

An errata sheet has been prepared for inclusion in the copies of the standard now in the Society's sales stock. Those wishing separate copies of the table may obtain them upon application to S. A. Tucker, Standards Manager, ASME, 29 West 39th Street, New York 18, N. Y.

The corrected table of preferred standards appears on this page.

CORRECTED TABLE FOR PREFERRED STANDARDS FOR LARGE 3600-RPM 3-PHASE 60-CYCLE CONDENSING STEAM-TURBINE GENERATORS

	Air-cooled generator	Hydrogen-cooled generator rated for 0.5 psig hydrogen pressure				
Turbine-generator rating, kw	11,500	15,000	20,000	30,000	40,000	60,000
Turbine capability, kw	12,650	16,500	22,000	33,000	44,000	66,000
Generator rating, kva	13,529	17,647	23,529	35,294	47,058	70,588
power factor	0.85	0.85	0.85	0.85	0.85	0.85
short-circuit ratio	0.8	0.8	0.8	0.8	0.8	0.8
Throttle pressure, psig	600	850	850	850	(850 or 1250)	(850 or 1250)
Throttle temperature, F	825	900	900	900	(900 or 950)	(900 or 950)
Number of extraction openings	4	4	4	5	5	5
Saturation temperatures at openings at "turbine-generator rating" with all extraction openings in service, F — 1st	175	175	175	175	175	175
2d	235	235	235	235	235	235
3d	285	285	285	285	285	285
4th	350	350	350	350	350	350
5th	...	...	...	410	410	410
Exhaust pressure, inches Hg abs	1.5	1.5	1.5	1.5	1.5	1.5
			Hydrogen-cooled generator operated at 15 psig hydrogen pressure			
Generator capability at 0.85 power factor, kva			27,058	40,588	54,117	81,176

A tolerance of plus or minus 10 F shall apply to above saturation temperatures. (Tolerances shall be unilateral so as not to reduce the spread in temperature between adjacent extraction openings.)

The "turbine capability" is guaranteed continuous output at generator terminals when the turbine is clean and operating under specified throttle steam pressure and temperature and $2^1/_2$ in. Hg abs exhaust pressure, with full extraction from all extraction openings.

American Standard Manlift Safety Code Proposed

TO MEET the long-felt need for a safety code covering manlifts, The American Society of Mechanical Engineers and the Association of Casualty and Surety Companies, acting as joint sponsors under the procedures of the American Standards Association, called an organization meeting of representatives of manufacturers, users, government agencies, specialists, and insurance companies, to draft a

suitable manlift safety code which would be acceptable to industry, governmental bodies, and safety agencies. The proposed code is expected to serve as a guide to state and municipal authorities whose safety laws and ordinances do not adequately cover safety requirements of manlifts.

The scope of the committee's job is outlined as dealing with construction, maintenance, and operation of manlifts in relation to accident hazards to employees and to the public. Manlifts covered by this scope consist of platforms or brackets mounted on, or attached to an endless belt, cables, chains, or similar method of suspension; such belt, cables, or chains, operating in a substantially vertical direction and being supported by, and driven through pulleys, sheaves, or sprockets at the top and bottom. The manlifts are intended for the conveyance of persons, or persons and materials. It is not intended that this scope cover moving stairways, elevators with enclosed platforms ("Paternoster" elevators), nor conveyers used only for conveying materials.

At the organization meeting to which engineers representing 35 national associations were invited, held Dec. 15, 1948, in the Engineering Societies Building, New York, N. Y., H. D. Smith, president, Globe Hoist Company, Philadelphia, Pa., was elected chairman. Norman W. Andrews of the Association of Casualty and Surety Companies, New York, N. Y., was named temporary secretary.

Subcommittee meetings have already been held in Philadelphia, Pa., and New York, N. Y., during which substantial progress was made in drafting outline of the proposed code, and preparing the nomenclature section. The co-operation evident at these meetings promises early completion of a draft for submission to industry for comment.

The next meeting of the new committee was scheduled for Tuesday, March 15, 1949, at ASME headquarters, 29 West 39th Street, New York, N. Y.

Coming Meeting Notes

World Power

"WORLD Energy Resources and the Production of Power" will be the theme of the Fourth World Power Conference to be held at the headquarters of The Institution of Civil Engineers, London, England, July 10–15, 1950. Some of the technical sessions will be held in the rooms of other leading technical societies in London. Following the conference, a series of study tours are planned. The technical program will be divided into three sections dealing, respectively, with energy resources, power developments, and the production of power.

Research

A symposium on co-operative engineering research will be held on the Minneapolis campus of the University of Minnesota, March 14–16, 1949. Sponsored by the University in co-operation with the Minneapolis section of the American Society for Engineering Education, the symposium will seek to promote better understanding and a closer relationship among the universities, industries, and government agencies.

The program will consist of an introductory presentation on the concept of co-operative research, followed by analysis, consideration, and discussion of the phases of co-operative research pertaining to universities, to industries, and to governmental agencies. The type of projects to which co-operative research is applicable will be considered. Other topics to be discussed will be the universities' role in such research; contracts, patents, and publications; and research personnel and their training needs. An attendance fee of $7 will be charged.

Boiler Code

The Boiler Code Committee of The American Society of Mechanical Engineers, in co-operation with the ASME Chicago Section and the National Board of Boiler and Pressure Vessel Inspectors, will hold its 1949 open meeting in Chicago, Ill., during the week of May 16, 1949.

Each year the Committee holds a regular meeting away from New York, N. Y., to give engineers in other industrial centers an opportunity to observe how the Committee conducts its business. Last year the Committee held one of its meetings in Boston, Mass.

Plasticity

The Second Symposium on Plasticity will be held at Brown University, Providence, R. I., April 4–6, 1949, under the joint sponsorship of the Bureau of Ships and the Office of Naval Research, Department of the Navy. The two principal topics of the Symposium will be "Structural Applications of the Theory of Plasticity" and "Dynamic Problems of Plasticity." Approximately one day will be devoted to miscellaneous contributions to theoretical or experimental phases of plasticity.

For further information write to Prof. P. S. Symonds, Graduate Division of Applied Mathematics, Brown University, Providence 12, R. I.

Hydraulics

Plans for the Fourth Hydraulics Conference to be held at Iowa City, Iowa, June 12–15, 1949, have been announced by the Iowa Institute of Hydraulic Research. The program will include five technical sessions, a guided tour of the new Institute facilities, and ample opportunity for informal gatherings. Thirteen correlated papers, constituting a symposium on present-day principles and methods of analysis, will be presented.

Corrosion

Forty-two technical papers are scheduled for delivery at the 1949 conference of the National Association of Corrosion Engineers to be held in Cleveland, Ohio, April 11–14, 1949. The conference will consist of 11 symposiums on such subjects as corrosion principles, cathodic protection, protective coatings, salt-water corrosion, and the corrosion problems of the chemical, electrical, and communications, pulp and paper, transportation, oil and gas industries.

Conservation

A symposium on the subject "The Conservation of Our Natural Resources," sponsored by the Engineers' Council of Houston, will be held at the Rice Hotel, Houston, Texas, April 2, 1949. Five papers will be presented.

Heat Transfer and Fluid Mechanics

The second annual meeting of the Heat Transfer and Fluid Mechanics Institute will be held June 22–24, 1949, on the Berkeley campus

EDITORIAL SUBGROUP AND GUESTS OF THE SECTIONAL COMMITTEE ON STANDARDIZATION AND UNIFICATION OF SCREW THREADS, B1, AT A MEETING AT THE RACKHAM MEMORIAL BUILDING, DETROIT, MICH., JAN. 14, 1949, WHERE THE FINAL EDITORIAL CHANGES WERE MADE TO THE UNIFIED AND AMERICAN SCREW-THREAD STANDARDS

(*Seated, left to right:* C. G. Davey, AC Spark Plug Division, General Motors Corporation; W. C. Stewart, American Institute of Bolt, Nut, and Rivet Manufacturers; H. W. Robb, General Electric Company; F. K. Brown, Continental Screw Company; F. P. Tisch, vice-chairman, B1, Pheoll Manufacturing Company; I. H. Fullmer, chairman, editing subgroup, National Bureau of Standards; W. H. Gourlie, Sheffield Corporation; F. E. Richardson, Munitions Board Standards Agency; H. A. Marchant, Chrysler Corporation; and P. M. Delzell, Ford Motor Company. *Standing, left to right:* R. F. Holmes, AC Spark Plug Division, General Motors Corporation; H. R. Cobleigh, ASME staff; S. A. Tucker, ASME staff; R. S. Burnett, SAE staff; P. V. Miller, Taft-Peirce Manufacturing Company; Glen Aron, Northrup Aircraft, Inc.; and W. L. Barth, General Motors Corporation.)

of the University of California under the sponsorship of California engineering schools and engineering and scientific societies. About twenty-five technical papers dealing with phases of the fundamental nature of heat transfer and fluid flow will be presented. Low-cost housing will be available in the University of California dormitories.

Metals

The 1949 Western Metal Congress and Exposition, sponsored by the American Society for Metals in co-operation with 20 technical societies, will be held in Shrine Convention Hall, Los Angeles, Calif., April 11–15, 1949.

Newest developments in producing, fabricating, and applying ferrous and nonferrous metals will be described during the congress by authoritative speakers from all sections of the United States.

Displays at the exposition will demonstrate what is new or improved in metals, metal-working equipment, and processes. Welding supplies, heat-treating equipment, foundry supplies, and machining equipment and tools will also be exhibited. Technical Sessions will be presented by ASM, AIME, American Welding Society, and the American Foundrymen's Association.

Wallboard Conference Scheduled

THE Northeastern Wood Utilization Council will hold a conference on the subject of wallboards on Sept. 16, 1949, in Cambridge, Mass., with the co-operation of Harvard University. The meeting, which is believed to be the first one of its kind, will cover both soft-boards and hardboards, their technology, and economics. The co-operating faculties at Harvard will be the Graduate School of Engineering and the Graduate School of Business Administration.

The conference will stress the production of wallboards from wood wastes, such as edgings, shavings, and sawdust. While there has been extensive research and development work on the subject, commercial realizations have been very few. It is believed that the chemical problems have been solved; thus the emphasis at the conference will be on the engineering and economic phases of the subject.

Papers will include descriptions of commercial units operating in this country, Canada, and Europe. Both the "wet" processes going through pulping and the "dry" processes which compress sawdust or other waste in a substantially dry form, will be looked into. One scheduled paper will discuss the relative merits of various adhesives, ranging from oils and starches to synthetic resins. Other topics of discussion will include continuous methods of manufacture, properties of the final boards, uses and substitutes, availability of raw materials, and a market survey of the potential demand.

Attendance to the conference will be limited to 75 in order to insure the proper discussion. Invitations can be obtained by corresponding with E. L. Heermance, secretary, Northeastern Wood Utilization Council, New Haven 6, Conn.

Awards

ROBERT L. HOSS, Mem. AIME, and member of the staff of the Humble Oil and Refining Company, Houston, Texas, was awarded the Alfred Noble Prize for 1948 for his paper "Calculated Effect of Pressure Maintenance on Oil Recovery," published in the September, 1947, issue of *Petroleum Technology* of the American Institute of Mining and Metallurgical Engineers. The presentation was made at the annual banquet of AIME held at the Palace Hotel, San Francisco, Calif., Feb. 16, 1949. Mr. Hoss is a graduate of the University of Tulsa.

The Alfred Noble Prize consists of a certificate of award and a sum of $350. It is awarded annually to a young member of one of the four Founder Societies or the Western Society of Engineers. The prize was established in 1929 and is administered by the American Society of Civil Engineers.

* * *

MORRIS E. LEEDS, chairman of the board, Leeds and Northrup Company, Philadelphia, Pa., was awarded the 1948 Edison Medal at the winter meeting of the American Institute of Electrical Engineers "for his contribution to industry through the development and production of electrical precision measuring devices and controls."

Education

INDICATIVE of the growing interest in applied mechanics is the recent announcement that Stanford University, Stanford, Calif., has established a division of engineering mechanics in its school of engineering.

The new division, which began its activities in January, 1949, administers a graduate program and grants masters and doctoral degrees in engineering mechanics, and will also co-ordinate sponsored research in this field.

According to Frederick E. Terman, dean, school of engineering, engineering mechanics is synonymous with applied mechanics. It is concerned with the strength, endurance, vibrational characteristics, and susceptibility to buckling of engineering structures and mechanisms. While the field goes back to Archimedes, it has been extensively developed in the last two hundred years through the mathematical theories of elasticity, elastic stability, solid and fluid dynamics, vibrations, and the plastic flow of metals.

S. P. Timoshenko, Fellow ASME, heads the executive committee which administers activities of the division. Others on the committee include James N. Goodier, Mem. ASME, Donovan H. Young, and Lydik S. Jacobsen, Mem. ASME.

A GIFT of approximately six million dollars was recently made to The Carnegie Institute of Technology by the W. L. and May T. Mellon Foundation for the purpose of establishing a graduate school of industrial administration.

At least one million dollars of the gift will be used to erect a building on the C.I.T. campus within two years, and the remainder to endow the new school. A three-year program will be offered including one year of graduate work leading to a master of science in industrial administration.

The need for the new school, according to C.I.T. authorities, is illustrated by the fact that well over 50 per cent of engineering graduates over 40 years of age are found in positions of administrative responsibility in industry.

Only college students who have demonstrated superior qualifications for its work will be selected for admission.

NEW YORK UNIVERSITY is co-operating with Stevens Institute of Technology in offering a new course entitled "Dynamics of Free and Controlled Bodies in Fluids." The course,

Meetings of Other Societies

March 6–9
American Institute of Chemical Engineers, Los Angeles regional meeting, Hotel Biltmore, Los Angeles, Calif.

March 10–12
American Society of Tool Engineers, annual meeting, Hotel William Penn, Pittsburgh, Pa.

March 14–17
Chicago Technical Societies Council, Chicago technical conference and production show, Stevens Hotel, Chicago, Ill.

March 24
National Industrial Conference Board, Inc., Hotel Waldorf-Astoria, New York, N. Y.

March 28–30
Society of Automotive Engineers, Inc., transportation meeting, The Statler Hotel, Cleveland, Ohio.

March 29–April 1
Greater New York Safety Council, Inc., 19th annual safety convention and exposition, Hotel Statler, New York, N. Y.

April 11–13
American Society of Lubrication Engineers, 4th annual convention and 2nd all-lubrication exhibit, Hotel Statler, New York, N. Y.

April 11–14
The National Association of Corrosion Engineers, annual conference and exhibition, Netherland Plaza Hotel, Cincinnati, Ohio.

April 11–15
American Society for Metals, western metal congress, Hotel Biltmore, Los Angles, Calif.

For ASME Coming Events see page 275)

which deals with the basic dynamic and fluid-dynamic aspects of submarine and surface vessels, is part of the co-operative curriculum known as "Fluid Dynamics of Aircraft and Airships" established jointly by the two schools in 1947. The curriculum is the first instance where two institutions in the metropolitan area have offered a defined course of instruction as a joint undertaking leading to a master's degree.

SIX $2000 Jet Propulsion Fellowships are being offered by The Daniel and Florence Guggenheim Foundation to qualified applicants who desire advanced professional training in this field of specialization. Three of these are for two years of postgraduate study at Princeton University, and three at California Institute of Technology, at the Jet Propulsion Centers established in 1948 by the Foundation.

Application forms have been sent to all schools and laboratories known to be working on rocket and jet-propulsion developments. Candidates may also obtain forms from The Daniel and Florence Guggenheim Foundation, 120 Broadway, New York 5, N. Y. Applications will be accepted until June 1, 1949.

People

D. S. JACOBUS and Comfort A. Adams will be guests of honor at an informal dinner to be held at the Hotel Astor, New York, N. Y., April 7, 1949, on the occasion of their retirement from the Boiler Code Committee of The American Society of Mechanical Engineers. Dr. Jacobus, who is the senior past-president and Honorary Member of the ASME, has been active on the Boiler Code Committee since 1914. To him is due a large measure of the credit for the universal recognition accorded to the Committee today. Dr. Adams, Fellow ASME, who has made numerous contributions to the theory and design of induction-heating apparatus and the science and art of electric welding, has served on the Committee since 1934. Both men will continue their association with the Committee in an honorary capacity.

E. G. BAILEY, Fellow and past-president ASME, has been invited to deliver the James Clayton Lecture of The Institution of Mechanical Engineers in London, England, April 22, 1949. Mr. Bailey's subject will be "Invention and the Sifting Out of Engineering Facts."

ROBERT M. GATES, Fellow and past-president ASME, will attend the Second National Conference on UNESCO (United Nations Educational, Scientific, and Cultural Organization), to be held in Cleveland, Ohio, March 31–April 2, 1949. Mr. Gates is the representative of the Engineers Joint Council on the United States National Commission for UNESCO. The conference, to which 3000 delegates representing all phases of American life have been invited, will discuss three topics: (1) Interchange of persons; (2) educational reconstruction in war-devastated countries; and (3) UNESCO as the educational arm of the United States.

FREDERICK J. GRAF, chief engineer, Massachusetts Bonding and Insurance Company, Boston, Mass., was appointed recently as the representative of The American Society of Mechanical Engineers on the President's Conference on Industrial Safety. Mr. Graf will serve on the Committee on Engineering which will consider "establishment of the techniques involved in the engineering approach to the control of accident hazards."

E. P. BROOKS, vice-president of Sears Roebuck and Company, in charge of factories, was recently named chairman, and Henry T. Heald, Mem. ASME, president, Illinois Institute of Technology, deputy chairman, of the Committee on Equipments and Materials of the Research and Development Board, National Military Establishment.

FRANKLIN THOMAS, professor of civil engineering, California Institute of Technology, Pasadena, Calif., was named president of the American Society of Civil Engineers for 1949 at the ASCE Annual Meeting held in New York, N. Y., Jan. 19–22, 1949.

Other officers elected were: Vice-presidents Henry J. Sherman, Camden, N. J., and Robert B. Brooks, St. Louis, Mo., both consulting engineers. Directors: Waldo G. Bowman, New York, N. Y., editor, *Engineering News-Record;* Morris Goodkind, New Brunswick, N. J., bridge engineer, New Jersey State Highway Department; Harold L. Blakeslee, treasurer, C. W. Blakeslee and Sons, Inc., New Haven, Conn.; Paul L. Holland, director of public works, Baltimore, Md.; Edmund Friedman, consulting engineer, Miami, Fla., and Prof. Sidney T. Harding, University of California, Berkeley, Calif.

JAMES F. FAIRMAN, vice-president of the Consolidated Edison Company of New York, New York, N. Y., was nominated for the presidency of the American Institute of Electrical Engineers at the AIEE annual meeting held recently in New York, N. Y.

Other officers nominated were: Vice-presidents: C. G. Veinott, Westinghouse Electric Corporation, Lima, Ohio; Walter J. Seeley, Duke University, Durham, N. C.; W. C. DuVall, University of Colorado, Boulder, Colo.; Ralph A. Hopkins, Westinghouse Electrical Corporation, Los Angeles, Calif.; and Arthur H. Frampton, English Electric Company of Canada, Ltd., St. Catherines, Ontario, Can. Directors: E. W. Davis, Simplex Wire and Cable Company, Cambridge, Mass.; Noel B. Hinson, Southern California Edison Company, Los Angeles, Calif.; Herbert J. Scholz, Commonwealth and Southern Corporation, Birmingham, Ala. Treasurer: W. I. Slichter, Mem. ASME, Columbia University, New York, N. Y.

ELECTION of Alfred E. Stacey, Jr., director of application engineering, Carrier Corporation, Syracuse, N. Y., as the 1949 president of the American Society of Heating and Ventilating Engineers, was announced recently at the annual meeting of the ASHVE, Stevens Hotel, Chicago, Ill.

Other officers elected were: First vice-president, Lester T. Avery; second vice-president, Lauren E. Seeley, Mem. ASME; treasurer, Ernest Szekely, Mem. ASME.

IME Secretary Knighted

HENRY LEWIS GUY, secretary since 1941 of The Institution of Mechanical Engineers, Great Britain, and Fellow of The American Society of Mechanical Engineers, was among the number of distinguished British subjects elevated to the knighthood by King George VI at the New Year's Day ceremonies.

Sir Henry began his engineering career in 1910 as a member of the mechanical department of the British Westinghouse Company, and in 1918 became chief engineer of the mechanical department of its successor, the Metropolitan-Vickers Electrical Company. His work in the steam-power field won for him a fellowship in the Royal Society in 1936 and three years later an honorary degree of doctor of science from the University of Wales.

He is the author of many engineering papers and the recipient of the 1927 Thomas Hawksley Gold Medal and the Parsons Memorial Medal.

Belgian Engineer Honored

A GROUP of 20 engineers met on Jan. 27, 1949, at a luncheon held at The Engineers' Club, New York, N. Y., given in honor of Ernest John Solvay, president, Société Royale Belge des Ingénieurs et des Industriels, of Brussels, Belgium. James M. Todd, president, The American Society of Mechanical Engineers, presided and presented two books to the honored guest as a memento of the occasion.

C. E. Davies, secretary ASME, introduced Mr. Solvay and said that he had been greatly impressed with the high quality of leadership the Belgian engineer had displayed at the conference of representatives from the engineering societies of Western Europe and the United States of America, held in London in October, 1948. In his response, Mr. Solvay paid tribute to his hosts and commented on the position of influence and leadership which had been forced on this country as a result of conditions in Europe.

Present at the luncheon were members of the Executive Committee of the ASME Council and of the Committee on International Relations of the Engineers Joint Council.

Industry Urged to Aid Scrap Drive

TO meet the increasing demands of the national economy, military, and the foreign aid program, for heavy iron and steel scrap, the United States Department of Commerce is calling upon American industry to support a heavy scrap drive currently under way.

Industry can best help the drive by appointing one top official in every plant to be salvage director with full responsibility to investigate heavy scrap possibilities and with full authority to sell any unneeded iron and scrap items. Items especially sought are obsolete dies, jigs, tools, fixtures, and other machinery. Farmers are being asked to search their properties for old farm machinery. Auto-wrecking yards are also being approached.

ASME NEWS

Many-Sided Program to Attract Large Attendance at ASME 1949 Spring Meeting

New London, Conn., May 2–4, 1949

A BALANCED technical program will be only one of the many features of the 1949 Spring Meeting of The American Society of Mechanical Engineers, to be held in the Mohican Hotel, New London, Conn., May 2–4, 1949. The Connecticut Sections of the Society, hosts at the Spring Meeting, are planning a series of social events, sight-seeing tours, and inspection trips which should make the meeting a memorable experience.

The tentative technical program for the meeting will be published in the April issue of MECHANICAL ENGINEERING. The following Divisions and Committees are sponsoring sessions: American Rocket Society, Aviation, Education, Fuels, Gas Turbine Power, Heat Transfer, Industrial Instruments and Regulators, Machine Design, Management, Materials Handling, Metals Engineering, Power, Process Industries, Production Engineering, Safety, and Textile.

Few New England cities offer a better introduction to the charm of old New England. Settled by John Winthrop 26 years after the first landing in Plymouth, Mass., New London takes pride in an antiquity that reaches back to the first days of the American colonies. Ubiquitous architecture and monuments remind visitors of New London's rich historical past. Still preserved is the schoolhouse in which Nathan Hale taught before he journeyed to Long Island to join the Revolutionary Forces. Not far from the center of the city is the Shaw Mansion, considered the cradle of the American Navy, which was the social center of Revolutionary New London and where Washington was often entertained. Across the Thames River the towering Groton Monument marks the site of old Fort Griswold to remind the citizens of how Benedict Arnold burned the city in his march through Connecticut in 1781.

New London has played an important part in the maritime history of America. In its harbor the first Naval expedition of the Revolutionary War was fitted out. With the return of peace New London ships sailed the seven seas. In 1794 the first whaling vessel to be sent from New London to the southern hemisphere left port. For more than 50 years thereafter the whaling industry provided the chief source of the city's fortunes, which laid the foundations for New London's industrial enterprises. Today the city is the commercial center of southeastern Connecticut. Its industries turn out submarines, textile machinery, cigarette paper, pharmaceutical products, Diesel engines, and others, and provide employment for its 40,000 people.

As the home of the Connecticut College for Women, the U. S. Coast Guard Academy, the Admiral Billard Academy, and the New London Junior College, New London is one of the educational centers of New England.

Historical Connecticut

For those who will travel to New London by automobile and who have not explored Connecticut, a veritable treat is the drive along the Boston Post Road, Route 1, from New York City. Small towns with many colonial structures still in use and most of them jealously guarding the village greens around which the early settlers built their homes and the beginnings of their towns, are pictures of the charm which is typical of New England. The larger cities with their multitudes of manufactures demonstrate the great importance of Connecticut in the country's industrial life. A day or two before or after the Spring Meeting, visiting the towns both large and small, will richly reward almost anyone.

Another route which the first-time visitor to Connecticut might take is by way of the Merritt Parkway which continues from the New York Hutchinson River Parkway through southern Connecticut to New Haven. On this parkway, a 55-mile legal speed limit provides a safe speedy trip along almost 60 miles of beautiful rolling countryside with no cross traffic to cause stops. Here one will see one of the most modern applications of highway, bridge, and landscape engineering in the nation, and one of which Connecticut is justly proud.

Women's Program

For entertainment of wives and relatives of members and guests, the Women's Committee of the Connecticut Sections, under the guidance of Mrs. Louis A. Lachman, has planned an excellent program which will feature visits to points of interest in and around New London. The program follows:

MONDAY, MAY 2

9:30 a.m.
Registration, room 205, Women's Headquarters, Mohican Hotel

10:30 a.m.
Bus trip to New London Junior College and Ocean Beach Park

12:45 p.m.
Luncheon at Ocean Beach Park

2:00 p.m.
Bus trip to Connecticut College for Women and the U. S. Coast Guard Academy

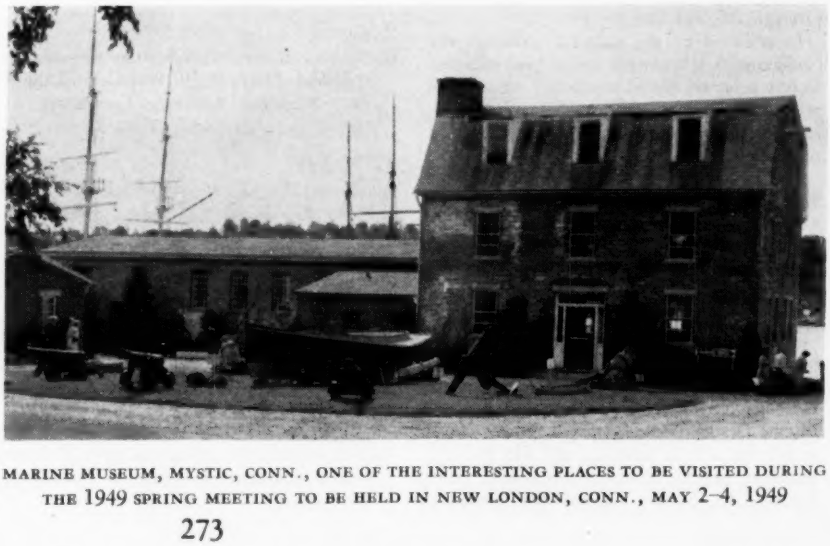
8:00 p.m.
Card party in Dutch Room, Mohican Hotel. Door prizes and prizes for each table will be offered.

TUESDAY, MAY 3

9:00 a.m.
Bus trip to Mystic Marine Museum

12:15 p.m.
Luncheon at the Mohican Hotel

2:00 p.m.
Bus trip to the U. S. Submarine Base at Groton, Conn., to witness maneuvers of submarines and to inspect the Submarine Base



MARINE MUSEUM, MYSTIC, CONN., ONE OF THE INTERESTING PLACES TO BE VISITED DURING THE 1949 SPRING MEETING TO BE HELD IN NEW LONDON, CONN., MAY 2–4, 1949

MODERN U. S. SUBMARINE OPERATING FROM THE SUBMARINE BASE, NEW LONDON, CONN. A VISIT TO THE BASE IS PLANNED FOR MEMBERS ATTENDING THE 1949 SPRING MEETING

5:30 p.m.

Cocktail party in solarium of Mohican Hotel

6:30 p.m.

Spring Meeting banquet in Ball Room

WEDNESDAY, MAY 4

9:30 a.m.

Bus trip to Hempstead House, Shaw Mansion, and Nathan Hale Schoolhouse

12:30 p.m.

Luncheon at Mohican Hotel

Should enough interest be shown in a bus trip to Guilford to inspect the famous Whitfield House, the oldest stone house in New England, this visit will be arranged for Wednesday afternoon at 2:00 p.m. The Rev. Henry Whitfield with a party of 40 colonists settled here in 1639 on land secured from the Indians by barter, and built this unique stone house, which is now a Connecticut Historical Museum.

Women's Committee

Members of the Connecticut Sections Women's Committee in charge of the women's program are: Wm. E. Hogan, chairman. *New London Section:* Mrs. John S. C. Barry, Mrs. Charles H. Coogan, Mrs. John S. Leonard, Mrs. L. A. Lachman, Mrs. Walter E. Beaney, Mrs. Howard E. Kuehn, Mrs. Erich R. Stephen, and Mrs. Oscar F. Willhelm. *Fairfield County Section:* Mrs. Cecil N. Hoagland and Mrs. John P. Heumann. *Hartford Section:* Mrs. Lester C. Smith and Mrs. Richard L. Weil. *New Haven Section:* Mrs. Albert S. Redway and Mrs. Edward H. Walton. *Waterbury Section:* Mrs. Thomas M. Rianhard and Mrs. Richard W. Simpson.

ASME 1949 Oil and Gas Power Conference to Discuss Diesel Progress

Hotel Sherman, Chicago, Ill., April 25–29

THE 1949 Oil and Gas Power Conference sponsored by the Oil and Gas Power Division of The American Society of Mechanical Engineers in co-operation with the ASME Railroad Division and the ASME Chicago Section, will be held at the Hotel Sherman, Chicago, Ill., April 25–29, 1949.

In addition to the technical program the conference will feature a special preconference lecture program for which special registration will be required, an exhibit of Diesel engines, accessories, and instruments, and inspection trips to the local Diesel plants.

Registration fee for the conference will be $2.50 to members and $5 to nonmembers. Registration for one day will be $1.25 and $2.50, respectively. Preprints will be free to those paying full registration fee.

Lecture Program

The preconference lecture course to be given on Monday, April 25, will consist of three lectures on the subject, "Gaseous Fluid Flow in Relation to Diesel and Internal-Combustion-Engine Design." Registration for the course is $12 for ASME members and $15 for nonmembers, payable in advance to John C. Gibb, Room 1323, Socony-Vacuum Oil Company, Inc., 26 Broadway, New York 4, N. Y. Those wishing to attend the lectures are urged to write Mr. Gibb without delay.

The lecture program follows:

MONDAY, APRIL 25

9:30 a.m.

Cooling of Internal-Combustion Engines, by B. Pinkel, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio.

12:15 p.m.

Luncheon; during which John T. Rettaliata, Mem. ASME, dean, school of mechanical engineering, Illinois Institute of Technology, Chicago, Ill., will comment on the lectures.

2:30 p.m.

Fundamentals of Air Flow in Diesel-Engine Manifolds, by W. W. Hagerty and L. Talbot, professors, University of Michigan, Ann Arbor, Mich.

7:30 p.m.

Reduction of Noise in Engines, by W. P. Green, professor, Illinois Institute of Technology, Chicago, Ill.

Diesel Engine Exhibit

The 1949 Diesel engine exhibit promises to be a larger attraction than ever before because of the excellent facilities at the Hotel Sherman for handling and exhibiting large pieces of equipment. Recognizing the educational value of technical exhibits, the conference program was planned to give members ample time to inspect the latest equipment in the Diesel power field.

Of interest to all engineers in the oil and gas-power field will be the organization meeting of the Oil and Gas Power Division's General Technical Committee which will be held on Tuesday evening, April 26. The meeting, to which all members and guests are invited, will explore how the Oil and Gas Power Division can best serve the technical interests of the oil and gas-power field.

Technical Sessions

Registration for the conference will begin at 6:00 p.m. on Monday, April 25. The first technical session will meet the next afternoon, following a general luncheon at which members and guests will be welcomed by officers of the ASME Oil and Gas Power Division, Railroad Division, and the Chicago Section. The tentative technical program follows:

TUESDAY, APRIL 26

12:15 p.m.

Welcoming Luncheon

2:00 p.m.

Session I

Dynamic Analysis of Valve Springs, by Troels Warming, assistant professor of mechanical engineering, University of Wisconsin, Milwaukee Extension, Milwaukee, Wis.

Vibrations in Valve Mechanism, by Troels Warming

Effects of Cylinder Pressure Rise on Engine Vibrations, by J. O. Hinze, "Delft" Laboratory, Royal Dutch Shell, Holland

8:00 p.m.

General Technical Committee Meeting

All members and guests interested in the oil and gas-power field are invited to participate.

WEDNESDAY, APRIL 27

9:00 a.m.

Session II

Two-Cycle Dual-Fuel Diesel Engine With Automatic Fuel Conversion, by E. L. Conn, R. H. Beadie, and G. A. Schauer, research staff of Fairbanks, Morse and Company, Beloit, Wis.

Diesel Locomotive Engine Cooling System, by F. H. Brehob, Locomotive Engineering Division, General Electric Company, Erie, Pa.

Ignition System for Oil Engines, by H. B. Holthouse, Holthouse Laboratory, Chicago, Ill.

1:30 p.m.

Inspection trip to new Diesel Locomotive Repair Shops of Chicago and North Western Railway

7:00 p.m.

Informal Banquet

Toastmaster: R. H. Morse, Jr., vice-president in charge of all operations, Fairbanks, Morse and Company, Chicago, Ill.
Speaker: R. B. McColl, president, American Locomotive Company, New York, N. Y.

THURSDAY, APRIL 28

9:00 a.m.

Session III

A Training Program for Railroad Personnel, by George Y. Taylor, supervisor, education department, locomotive division, American Locomotive Company, Schenectady, N. Y.
Diesel-Engine Maintenance Instruction, Alco V Type Engine, by S. E. Lodge, education department, locomotive division, American Locomotive Company, Schenectady, N. Y.

1:15 p.m.

Inspection trip to La Grange Plant of Electro-Motive Company

2:00 p.m.

Inspection trip to submarine containing four 1600-hp Fairbanks, Morse Diesel engines

FRIDAY, APRIL 29

All-day trip by train to the shops of Fairbanks, Morse and Company, Beloit, Wis.

4000 Attend 1949 ASME Materials Handling Conference

As sponsors of the Materials Handling Conference at the third National Materials Handling Exposition held at Convention Hall, Philadelphia, Pa., Jan. 10–14, 1949, the Materials Handling and Management Divisions of The American Society of Mechanical Engineers, in co-operation with the Materials Handling Institute, provided a valuable service to engineers and executives of automotive, railroad, textile, and food-processing industries who came to the exposition from all sections of the country to see the latest designs and improvements in fork-lift trucks, elevators, cranes, and hoists.

Nearly a quarter of the 17 thousand who registered at the exposition participated at the eight morning and afternoon sessions at which experts in the field of materials handling discussed such topics as outlook for the industry, new improvements in methods and equipment, case histories of the application of modern handling equipment, and the future of the industry.

Proceedings of the conference are in process of publication and may be purchased for $2 a copy from the ASME, 29 West 39th Street, New York 18, N. Y.

Speaking at the opening session, Charles F. Roos, president of the Econometric Institute, Inc., New York, N. Y., reported that since 1939 the total physical output of the materials-handling industry had increased about 160 per cent. This increase, however, was in line with increases in other capital goods industries. The greatest expansion, he said, was in the use of the fork-truck-pallet combinations. These developments appeared to have reached the limit of special exploitation and if there were no new technological developments peculiar to the materials-handling industry, its production was likely to follow the general pattern set by other capital-goods production. He predicted that if there were no new taxes, the industry was likely to see a decline in unit sales or physical volume of 15 to 20 per cent in 1949.

Another speaker called attention to the opportunities for sales engineering by pointing out that in certain industries 25 per cent of the cost of production was represented in the expense of moving goods and materials. Most of this expense was represented, he said, by cumulative pay rolls and added nothing to the product but cost.

Modern Methods Engineering

Speaking at the Tuesday afternoon session, Harold B. Maynard, Mem. ASME, president, Methods Engineering Council, Pittsburgh, Pa., defined methods engineering as a group of techniques used to find the most effective way to accomplish any useful task. These techniques included, he said, process charts, operation analysis, motion study, and time study.

The methods engineer seeks first to eliminate materials handling before trying to find the

TWO-MILLION-DOLLAR DIESEL LOCOMOTIVE SUPERSERVICE STATION OF THE CHICAGO AND NORTHWESTERN RAILWAY SYSTEM. AN INSPECTION TO THE PLANT IS INCLUDED IN THE 1949 OIL AND GAS POWER CONFERENCE TO BE HELD AT THE HOTEL SHERMAN, APRIL 25–29, 1949.

ASME Calendar
of Coming Events

April 25–29
ASME Oil and Gas Power Division Conference and Exhibit, Hotel Sherman, Chicago, Ill.

May 2–4
ASME Spring Meeting, Hotel Mohican, New London, Conn.

June 13–15
ASME Applied Mechanics Division Conference, H. A. Rackham School of Graduate Studies, University of Michigan, Ann Arbor, Mich.

June 27–30
ASME Semi-Annual Meeting, University of California, Extension Building, San Francisco, Calif.

Sept. 12–16
ASME Instruments and Regulators Division Conference and Exhibit, Municipal Auditorium, St. Louis, Mo.
(Final date for submitting papers—May 1, 1949)

Sept. 27
ASME Wood Industries Division Conference, Jamestown, N. Y.
(Final date for submitting papers—May 1, 1949)

Sept. 28–30
ASME Fall Meeting, Lawrence Hotel, Erie, Pa.
(Final date for submitting papers—May 1, 1949)

Oct. 2–5
ASME Petroleum Division Conference, Oklahoma Biltmore Hotel, Oklahoma City, Okla.
(Final date for submitting papers—June 1, 1949)

Oct. 26–27
ASME Fuels Division Conference, French Lick Springs Hotel, French Lick Springs, Ind.
(Final date for submitting papers—June 1, 1949)

Nov. 27–Dec. 2
ASME Annual Meeting, Hotel Statler, New York, N. Y.
(Final date for submitting papers—August 1, 1949)

(For Meetings of Other Societies see page 271)

most effective materials-handling method. He knows that materials handling goes on from the very start of the process until the finished product is in the hands of the ultimate consumer. This means that handling problems exist outside the plant, problems more serious in their cost increasing effects than those inside the plant, Mr. Maynard said.

Recently, he reported, a whole industry set out to improve its materials-handling methods. A co-operative study by various companies in the industry revealed some very good and some very poor methods. By synthesizing the best methods, it was possible to develop one which was better than any used before the study was undertaken. Out of the data obtained it was possible to outline an ideal method which could be built into future plants.

While many companies have done much to improve materials-handling methods, Mr. Maynard continued, much remains to be done, for often only obvious improvements have been made. These changes yielded important savings but were a fraction of the ultimate savings possible. What is needed, Mr. Maynard said, is more digging into details, more painstaking analysis, more careful searching for new and better methods. These studies take time and call for an increased number of competent engineers, and patience on the part of management in waiting for results. Only in this way can we hope to keep on increasing our American standard of living, he said.

More than a thousand persons attended the session on work simplification at which Allan H. Mogensen, consultant engineer, New York, N. Y., spoke on the relationship between methods improvements and materials handling. He discussed from a refreshing point of view some of the advance techniques of work simplification and how they were being received by labor.

Case Study

At the Wednesday morning session devoted to case studies in application of modern materials handling, C. M. Harris, production engineer, Electrolux Corporation, Old Greenwich, Conn., told how use of industrial fork trucks, pallets, portable rollers, roller skates, and belt conveyers in the various departments of his plant solved the problems of handling, storing, and shipping materials necessary to produce vacuum cleaners at a rate approximately four times the prewar rate.

Mr. Harris reported that, by emphasizing the possibilities of eliminating the physical labor as well as the hazards commonly associated with the strong-arm method of handling carboys, drums, and sheet and coiled steel, the installation of each piece of new equipment was accepted with enthusiasm by the men assigned to the job. Also, by exercising great care in the selection of drivers of the powered materials-handling equipment, it was possible to operate three and a half years without any accidents or injuries to personnel.

Advances in Technique

One of the latest developments in materials-handling equipment was described by M. Landon, engineering department, Sun Oil Company, Philadelphia, Pa. This was an automatic pallet loader which bridges the gap between the end of a carton-producing line and the palletized warehouse or shipping platform. Originally designed to handle cartons, it can be easily adapted to handling of bags, drums, or bricks.

Future Problems

The last session of the conference was devoted to considerations of the materials-handling problems of the future. Harry A. Davenport, of the New York Port of Embarkation, Brooklyn, N. Y., stated that the biggest handling job in the world was accomplished by the Armed Forces during the recent war.

Describing the scale of World War II activities he said: "More than 125 million tons were handled by Army ports of embarkation. The peak was reached in March, 1945, when about 6 million measurement tons were dispatched, or about 190 thousand tons per day. In addition to the movement of supplies and equipment, the Transportation Corps transported nearly $7^1/_2$ million persons from the United States to overseas destinations and returned them. Let me dispel any impressions that the job was of small magnitude after hostilities ended. During the first 9 months of 1948, approximately 10 million measurement tons of various cargo were moved by the New York Port of Embarkation and its outports. Of major importance to the success of any materials-handling system are the appropriate layout and adequate construction of installations—in this case, ports of embarkation. Outstanding among ports the world over is the New York Port of Embarkation, which experts consider an excellent example of good industrial design and long-range planning.

In order to study the many individual problems concerning the movement of military cargo, the Transportation Corps, he said, "has initiated a research and development project entitled, Standardization of Military Cargo Transportation. This project has, as its ultimate goal, improvements in the broad field of military cargo transportation, from the initial points of supply to the ultimate user in any overseas theater of operation." This project covers: (1) Unit packaging; (2) palletization; (3) utilization of common carriers; (4) loading and unloading at military depots, posts, camps, or stations; (5) ship loading and stowage at ports of embarkation; (6) study of materials-handling equipment peculiar to various types of overseas operations; (7) study of overseas military transportation equipment; and development of field type, highly mobile materials-handling equipment for use at advance bases.

ASME Tour Party Growing

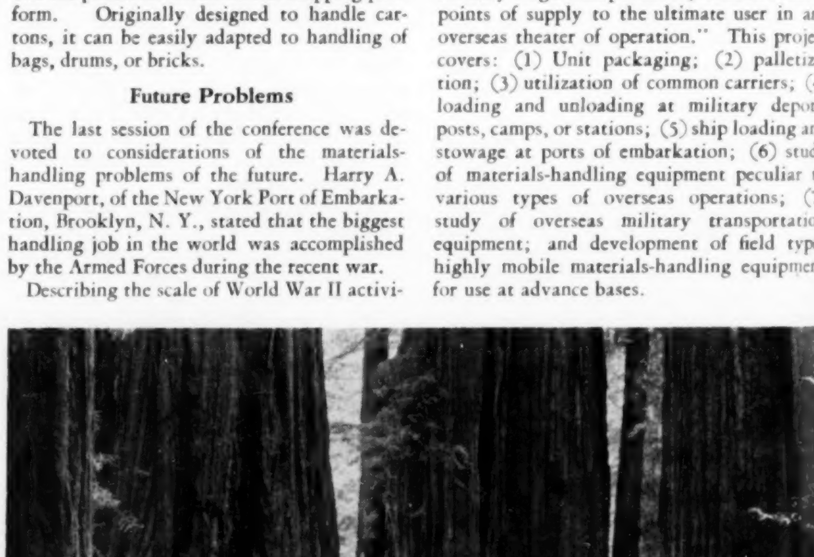
June 18–July 14

ASME members are daily expressing interest in the 1949 ASME Vacation Tour planned in connection with the ASME Semi-Annual Meeting to be held in San Francisco, Calif., June 27–30, 1949.

The tour will include stops at the Grand Canyon National Park, the 200-in. telescope at Mt. Palomar, Grand Teton National Park, Los Angeles, the Redwood Forests, Portland, Ore., Yosemite National Park, Mt. Rainier National Park, Yellowstone National Park, Seattle, the Columbia River, and the Shasta Dam.

Arrangements can be made for side trips to Hawaii and Alaska.

Write to the secretary for itinerary.



REDWOOD FOREST IN HUMBOLDT COUNTY, CALIF., ONE OF THE STOPS ON THE ASME VACATION TOUR TO THE 1949 ASME SEMI-ANNUAL MEETING TO BE HELD IN SAN FRANCISCO, CALIF., JUNE 27–30, 1949

Role of Research as an ASME Activity[1]

BACKGROUND research is a form of industrial insurance for tomorrow, and is helpful in meeting competition. To carry on research we must have people who possess the tools needed for the creation of new knowledge.

The American Society of Mechanical Engineers, through its Research Committee, has an opportunity to keep the importance of research constantly before its members, and may aid in insuring an adequate supply of research-minded engineers by co-operation with research agencies and engineering colleges.

The Society has, therefore, a responsibility to encourage background research in mechanical engineering in order to keep our progress abreast of the times and developments. In this troubled world the Society has the added responsibility of co-operating in all phases of military research pointed toward the defense of this nation.

Objectives

The ASME Research Committee under the direction of the Board on Technology should concentrate on the following two main objectives:

1 Encourage and direct background research by various means which will extend the boundaries of knowledge within the areas of interest covered by the Society.

2 Aid in all possible ways to encourage capable mechanical engineers to receive advanced education so that they will be equipped with suitable tools and be better qualified to carry on the research coming within the areas of interest of the Society.

To date the Research Committee has limited its activities to the first objective by encouraging and directing applied research. The activities of the Committee should not be concerned with the development or improvement of commercial products, as this is a primary responsibility of industry. It should act as an agent to stimulate research of a background nature, which is common to one or more industries. Acting as a catalyst the Committee should attempt to assist in sponsoring research along broad lines for various groups, which may be too general to be of specific interest or too expensive for any one company to undertake.

In order to carry out its objectives, special and joint research committees are appointed under the jurisdiction of the Research Committee for the purpose of investigating or guiding specific research problems.

The Society has no funds specifically budgeted to sponsor background research; hence funds for projects administered by the ASME must come primarily from industry or interested organizations. In order to defray the staff expense, a small overhead charge is made against the contributed funds.

Responsibility to the Board on Technology

Administrative details relative to ASME research are primary functions of the Research Committee and in turn the special and joint research committees. Matters of policy require the approval of the Council. In order to facilitate effective operation the Council has delegated approval of policy matters to the Board on Technology. In general, the Research Committee transmits recommendations on the following items to the Board on Technology for final action: (1) The organization or dissolution of special and joint research subcommittees; (2) proposed new background research projects which are to be Society sponsored; (3) means and methods for soliciting funds for new research projects; (4) agreements and contracts for and with research agencies interested in undertaking research projects sponsored by the Society; and (5) agreements with other organizations relative to Society or intersociety research programs.

Functions

In order to execute effectively the first objective of the Research Committee the following functions are carried out:

1 Supervise and administer the background research sponsored by the Society.

2 Co-ordinate the research work supervised by the special committee so that unnecessary duplication may be avoided.

3 Evaluate the various research programs to ascertain those which should be discontinued, postponed, or expedited.

4 Annually review the progress made by each of the special research committees and decide what action should be taken.

5 Supervise the expenditures of budgeted amounts established for research projects.

6 Classify and decide where each new research project should be assigned as regards to the respective special research committee.

7 Scrutinize and review all new research projects submitted to the Society.

8 Review suggested plans for financing each approved research project.

9 Study all agreements and contracts with research agencies, paying attention to section on patents, insurance, and other items which directly affect the Society.

10 Encourage the research secretaries of the Professional Divisions to actively consider worthy research projects of the Division.

11 Consider and recommend appointments to research committees and special activities of other societies or organizations.

12 Review all proposals for co-operative research adventures with other societies, federal agencies, and organizations.

Recommendations

As the retiring chairman of the Research Committee, I wish to make the following recommendations and remarks relative to the functioning of the Committee:

1 I wish to acknowledge the assistance given to the Committee by the staff. Their untiring efforts and enthusiastic support have been most helpful during my term of office.

2 The time has now come when the Research Committee must make every effort to work closely with other committees of the ASME to encourage the outstanding engineers to pursue advanced study to better qualify them to carry on research in areas encompassed by the general field of mechanical engineering. Thus it is desirable to spread more projects to many institutions rather than to concentrate all funds in a few well known agencies.

3 The Committee should undertake to encourage the Research Secretaries to take an active part in bringing background-research problems of their divisions before the Committee.

[1] Talk given by G. A. Hawkins, chairman, ASME Research Committee for 1947–1948, during the 1948 Annual Meeting at a conference sponsored by the Professional Divisions Committee to discuss the subject, "Better Professional Divisions for a Better Society."

1948 Annual Meeting Attendance

OFFICIAL count of the attendance at the 1948 Annual Meeting of The American Society of Mechanical Engineers shows that 5296 members and guests including members of the American Rocket Society, participated in the meeting.

This is a new record for the Society being 130 higher than the largest previous attendance at any ASME Annual Meeting. Ratio between the number of members and guests has changed markedly since the $5 nonmember registration fee was introduced for the first time at the 1947 Annual Meeting in Atlantic City, N. J. When registration was free to all, the largest member-to-guest ratio was 1.6 to 1. At the 1948 Annual Meeting it was 3.3 to 1.

The 1948 meeting was also notable for the large increase of student and Woman's Auxiliary registrations which were 70 and 150 per cent, respectively, over those of the last Annual Meeting held in New York.

The delegates represented 41 states, District of Columbia, Canada, and 12 foreign countries.

1949 Society Records Sent Upon Request

MEMBERS of The American Society of Mechanical Engineers who wish to receive copies of the February, 1949, issue of Society Records containing council and committee personnel, or the March, 1949, issue containing memorial biographies, are requested to fill out and send the following form to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y. In accordance with the new policy recently adopted by the Council, the March, 1949, issue of Society Records will be the last to contain memorial biographies.

Please send me a copy of the Society records for

☐ February, 1949 (Personnel)

☐ March, 1949 (Biographies)

Name..............................

Address..............................

ASME Junior Forum

COMPILED AND EDITED BY A COMMITTEE OF JUNIOR MEMBERS, B. H. EDELSTEIN, CHAIRMAN

National Junior Committee Reviews Record and Plans Future

AT AN all-day meeting in the rooms of the Society, New York, N. Y., on Feb. 5, 1949, the National Junior Committee subjected its two-year record to searching analysis and came to the conclusion that, although its work had only touched the surface of its responsibility, the record showed substantial achievement.

Present at the meeting were: D. E. Jahncke, chairman, C. H. Carman, Jr., F. Everett Reed, H. D. Moll, B. H. Edelstein, A. F. Bochenek, staff, A. R. Mumford, vice-president, ASME Region II, and C. E. Davies, secretary ASME.

Addressing himself first to the question whether continuation of the Committee was justified, Mr. Jahncke compared the current state of junior affairs against the conditions which existed when the committee was created. In January, 1947, he said, there was a general discontent among junior members caused by a feeling that the Society was not much concerned with their problems. Juniors were under pressure to join unions and to sacrifice professional ambitions for temporary monetary gains. There was no Junior Forum in which gripes could be aired nationally. Prewar junior groups were in a state of disorganization and no national body was working to correct the situation.

While the Junior Committee could not take credit for the Taft-Hartley labor law which corrected the union situation, he said, two of its projects have done much to make junior members aware of the Society's interest in their welfare. As a result of the pamphlet "It's Up to You," which succinctly states a philosophy of self-help and blueprints procedures for junior group organization, many new junior groups have been organized and inactive ones reorganized. The Forum each month now gives space in MECHANICAL ENGINEERING to comment by juniors on Society affairs. How much the situation has improved was evident, he said, from the difficulty now experienced by the Forum Editorial Committee in finding material to publish. Junior members may still be discontented, but they did not appear to be so deeply disturbed about the Society as to express themselves in writing.

Function of Committee

At its meeting on July 31, 1948, the Committee interpreted its function to be "to develop policies and procedures by which junior members' participation in Society activities is assured." A roll call of the Committee revealed that the statement was still valid. Two policies were suggested which needed the attention of the Committee. These were: (1) To awaken junior groups to the job of encouraging student members to transfer to junior membership; and (2) to arouse the Society to the need of trimming its program material to hold the interest of junior members.

H. D. Moll of the Philadelphia Section described the Philadelphia Plan for working with the student branches in that area. Because junior members speak the language of students they are the logical members of the Society to interpret the ASME to students and to show them how to utilize the opportunities for professional development made possible by Society membership.

The idea was expressed that if the Society programs do not hold the interest of junior members, the responsibility for the condition rests with the Junior Committee. In planning programs, Society officers are often handicapped by lack of knowledge of what junior members want. The initiative rests with the juniors themselves. It is in the province of the National Junior Committee to urge Society leadership to take under consideration programs of special junior appeal and to take positive action in such matters as registration and improvement of the juniors' economic status.

Junior Advisers

If the National Junior Committee was to face its responsibilities, it was recognized that the Committee should be strengthened to include juniors currently serving as junior advisers on such national committees as the Publications, Meetings, and Professional Divisions Committees. All junior advisers should be a part of the National Junior Committee, so that it could serve as a clearing house for junior thinking on all matters pertaining to the Society. Junior advisers, it was felt, should attend meetings of the National Junior Committee to report informally on activities of their respective committees. A discussion of these matters before the committee would aim in formulating junior policy and benefit the advisers by making them more aware of their role as spokesman for junior members.

The dearth of contributions to the Junior Forum from junior members residing in Regions distant from New York was brought before the Committee by B. H. Edelstein, chairman of the editorial committee composed of junior members of the Metropolitan Section. The problem was an old one, he said, but could be corrected by implementing the scheme of having editorial advisers in each Region. Correspondence with outlying junior members has lagged, he said, because of the lack of secretarial help.

The problems will be solved in the future by dividing the task among members who have secretarial help available and by relying on professional stenographers.

Annual Meeting Program

Acting upon the suggestion made by Past-President Eugene W. O'Brien at the 1948 Annual Meeting, that the Junior Committees sponsor a session at the 1949 Annual Meeting, Mr. Carman and Mr. Moll were assigned the task of working up an appropriate plan. The idea is to hold the meeting immediately following the Members and Students Luncheon so that students could participate. Speakers are to be invited to speak on some general professional topic. Talks by student members will also be considered.

As a result of the long discussions, which were virtually bouts with the intangibles involved in the relationship of the junior member to his Society, the Committee was able to crystallize objectives and to evolve a sense of direction which renewed confidence and enthusiasm in its work.

Metropolitan Junior Group Discusses Economic Status

AT A meeting sponsored by the Junior Group of the Metropolitan Section of the ASME the topic, "Bringing the Junior Engineer Up to Date on His Economic Status," was discussed. The meeting was held in the Engineering Societies Building on Jan. 13, 1949. John H. Prentiss, Jun. ASME, acted as chairman and introduced the four principal speakers. Later he led a spirited discussion in which 60 men participated.

Gregory L. Laserson, Jun. ASME, the first speaker, presented the results of a study made by a subcommittee of the Metropolitan Junior Group on the data compiled in "The Engineering Profession in Transition." These data were obtained by a survey conducted among the members of five engineering societies by the Bureau of Labor Statistics for the Engineers Joint Council. This study, later made into a report, showed the breakdown of professional classifications, average wages earned by engineers on the basis of years of experience, and a comparison of cumulative wages earned by a design engineer and a building-trades worker. Since the majority of employed engineers were in the design-engineering classification, this group was selected as typical and a more detailed study of their status was made.

"This showed," Mr. Laserson said, "that the engineer does not get a salary commensurate with his training, duties, and responsibilities."

S. A. Folsom, as a delegate of the Council of Western Electric Union Engineers, was the next speaker. He gave a brief history of the union with which he is affiliated. In the organization 80 per cent of the members are college graduates, and the classifications that are represented are those which Western Electric Company would normally fill with highly specialized men. These points were made by Mr. Folsom to show that his was not a catch-all union, but one of engineers exclusively. They have made many surveys in conjunction with engineering groups of other major companies, and have used these surveys for bargaining purposes. As a point of interest Mr. Folsom mentioned one survey to find what engineers looked for in their jobs. First on the list for most men was congeniality, while, surprisingly enough, last on the list was security.

R. P. Kellogg, manager of the professional section of the New York State Employment Service, was next introduced by Mr. Prentiss. Mr. Kellogg first mentioned the great variation in jobs offered to mechanical engineers at the NYSES: From $40 per week for a mechanical engineer with $2^1/_2$ years' experience to $5500 per year for one with a minimum of three years' aircraft experience. According to Mr. Kellogg there was currently a surplus of young inexperienced engineers in New York City, and many of these were leaving the area. There was also a surplus of production men and sales engineers. The demand today, he said, was for highly specialized men, such as electronics engineers and automatic-machine designers. "Engineers," he said, "may face a saturated market by 1950. We should know then what the personnel manager looks for in the engineers that he is hiring." Mr. Kellogg places technical competence at the top of this list. The prospective engineering employee should also have a genuine respect and liking for people, the ability to take and give criticism gracefully, and the co-operative spirit to work as part of a team.

Engineering Talent Cheap

Bernard Haldane of Executive Job Counselors, Inc., the final speaker of the evening, prefaced his talk with the following remark: "Engineers are people who have brains that can be bought at the lowest price." The reason, Mr. Haldane was quick to point out, rests with engineers themselves. They are too specialized; they think that management is not supposed to understand their language. Engineers approach a problem from a mechanical point of view, without trying the humanistic approach. "If we, as engineers, want to improve our individual positions in the face of increased competition, we had better find out what we have to offer. We should let management know that we're on the producing side." Mr. Haldane suggested that we sit down with ourselves and prepare a semi-annual or annual report on what our individual progress is in the organization. In closing, Mr. Haldane again reminded engineers not to get lost in their technology, but try to keep the personal touch at all times.

At the conclusion of Mr. Haldane's talk, the four speakers engaged in a round-table discussion of the points they had raised during the evening. Mr. Prentiss, as moderator, invited audience participation. The ensuing comments were lively and showed the concern that the audience of young engineers had about the problem.

Best Advice

PROBABLY the best advice to the young engineer just starting engineering life is to make himself generally agreeable, useful, and dependable without bootlicking, and never, under any circumstances, "high-hat" anybody.[1]

Juniors Interpret Report on Economic Status

A REPORT of more than cursory interest was discussed at a recent meeting of the Junior Group of the Metropolitan Section in New York, N. Y. This report was prepared by a subcommittee on Professional and Economical Status Development, which was part of a comprehensive program undertaken jointly by the juniors and members of the ASME Metropolitan Section. The subcommittee attempted to analyze, or perhaps more aptly, translate the wealth of information contained in the report, "The Engineering Profession in Transition,"[2] published by the Engineers Joint Council in the spring of 1947.

The information contained in the EJC report was divided into four main sections, the first dealing with percentage distribution of the engineering profession by occupational status and general field of employment in 1946. Since the figures revealed that 36.9 per cent of the engineers were either self-employed or on a management level and would consequently have problems at variance with the other group, it was decided by the Metropolitan juniors that the groups would be analyzed separately; also, that the employee engineer would be the prime consideration, with design engineers being the most appropriate single group because they represent 25 per cent of all employee engineers.

Section 2 of the report dealing with the median base monthly salary rates of professional engineers by occupational status in 1946 disclosed that there are five general wage levels, as follows: (1) Administration (management, nontechnical; management, technical); (2) research in basic science, research applied, and editing and writing; (3) consulting as employee of private firm, sales, independent consulting, development, production; (4) operation, teaching college or university, design; and (5) inspection, maintenance, analysis and testing, drafting.

Wide Spread in Salaries Noted

The report claims that there is a wide spread in salaries between the management level and the employee group, reflecting a possibility of too little appreciation of the employee-engineer problem on the part of the management-engineer group. For comparison, included in this graphic presentation was the construction-worker group whose income was determined by taking a 40-hour week and using hourly rates given by the New York City Building Trades Council. The report noted that it not only takes a design engineer 10 years to equal the construction worker's income, but he spends four years in college which the construction worker puts in as an income-receiving apprentice.

Section 3 of the report makes a comparison of cumulative earnings. Astonishingly, after 45 years (including college) the median design engineer has not yet equaled the cumulative earnings of the construction worker (exclusive of any overtime for the latter). Unfortunately, although an engineer should look forward to openings in management, the EJC report shows only 36.9 per cent of all such positions are at this level, so that for the other 63.1 per cent the construction-worker-design engineer comparison is still pertinent, especially since construction workers as well can advance to supervisory and management levels.

Validity of Conclusions Questioned

While these conclusions were generally accepted by the audience, further analysis of supporting data after the meeting by some of those present indicated that the conclusions were open to serious question.

Section 4 covers the median annual income of professional engineers from 1929–1946. An examination of the curves discloses that younger engineers were affected by the depression to a far greater extent than the older men. The younger engineer had to take the largest income reduction on a percentage basis, indicating the inverse relationship between the percentage education and the years of experience.

In conclusion the report states that "the economic status of employee engineers is not commensurate with the training, duties, and responsibilities which their profession necessitates" and can be seen as a distinct danger to the entire engineering profession if not soon adjusted.

Three Great Men

LEONARDO DA VINCI, Benjamin Franklin, and Thomas Alva Edison were builders of bridges between the science of their day and the mechanical arts that affected the daily living of the rank and file of their country, Harvey N. Davis, president, Stevens Institute of Technology, Hoboken, N. J., recently told the graduating class of Rensselaer Polytechnic Institute, Troy, N. Y. Dr. Davis, who is past-president and Hon. Mem. ASME, addressed the graduates after receiving an honorary degree of doctor of engineering.

"Leonardo, for example, tried to improve the sanitation of Milan," Dr. Davis said. "He built canals and locks, and lock gates of types that were standard for more than four

[1] New Proverbs for Young Engineers, by Philip W. Swain, editor, *Power*, McGraw-Hill Publishing Company, Inc., New York, N. Y. Mem. ASME.

[2] Digest published in September, 1947, issue of Mechanical Engineering, pages 732–734.

centuries. He even devised, though he never tried to build, a rapid transit subway system for Milan. In these and many other ways he strove to put to work for the common good as he saw it the science of his day, including much that he himself had discovered. We at Stevens are a bit partial to him for we have in the Lieb Library a collection of Vinciana unsurpassed in this country for scholars to browse in."

Although Leonardo was "a youth of shining promise" and his pioneering in many branches of science might have been of tremendous value to mankind, he had the weakness so often found in multiaptitude men, Dr. Davis pointed out. Leonard seldom finished a commission.

"One thing you should certainly learn from him," Dr. Davis told the graduates, "when you undertake something, see it through, finish it up, bring it to a worth-while conclusion.

Benjamin Franklin's lifelong habit of putting his scientific speculations to homely practical use, made him a notable bridge builder between science and the mechanic arts, Dr. Davis brought out. "He gave the impulse to nearly every measure or project for the welfare and prosperity of Philadelphia undertaken in his day."

Almost all of Thomas Alva Edison's life was devoted to the invention, improvement, and development of projects of practical importance for the benefit of his and future generations, Dr. Davis said, in offering a third example for the engineers of today.

"The building of bridges between science and the mechanic arts is even more important today than ever before, and it is the job of the engineer to build them," Dr. Davis asserted. To those whose future might lie in invention, research, or development, he advised, "You must first know your science thoroughly. More and more the important advances in engineering practice are stemming from what our fathers would have called hopelessly 'pure' science.

"On the other hand," he reminded his audience, "your contribution to bridge-building may prove to be of quite a different kind. It has been said that a brilliant idea is only five per cent of the way toward a going concern. The other 95 per cent of the way is in the hands of good management, and that is where a large majority of you will find your careers.

"The three great men I have mentioned had one striking mental trait in common, . . . not only a wide range of interests, but an insatiable curiosity as to the why's of everything that crossed their horizons. No one of them was ever satisfied by the mere voice of authority. Every one of them wanted to think things out for himself, and to get experimental verification of his thinking.

"If you stay alive mentally, you can bear even great prosperity with equanimity and still serve mankind greatly," Dr. Davis said.

Partners in Success

TO succeed an engineer must know how to get along with the man above, the man alongside, the man below, and with his ownself.[1]

Activities of the ASME Executive Committee

At a Meeting Held at Headquarters, Jan. 27, 1949

A MEETING of the Executive Committee of the Council was held in the rooms of the Society, Jan. 27, 1949. There were present: James M. Todd, chairman, F. S. Blackall, Jr., E. J. Kates, Forrest Nagler, T. E. Purcell, H. V. Coes (Finance Committee), K. H. Condit (Organization Committee), K. W. Jappe, treasurer, E. G. Bailey, past-president, A. R. Mumford, vice-president Region II, C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary.

Registration Fees

Action by the Board on Technology authorizing the Meetings Committee "to charge a nonmember registration of $5 for Annual Meetings and $3 for Semi-Annual, Spring, and Fall Meetings," was noted.

EIC-ASME Meetings Privileges

Upon recommendation of the Meetings Committee, concurred in by the Board on Technology, the request of the EIC-ASME Joint Conference Committee that members of the two societies enjoy the membership privileges of attendance at meetings of each society was approved.

Nuclear Energy Glossary

The Nuclear Energy Application Committee reported that substantial progress had been made in the preparation of the Nuclear Energy Glossary, and that three of the eight sections have been completed.

Recognizing Deceased Members

Letter-ballot approval of a modified policy for recognizing deceased members as recommended by the Publications Committee was noted. The modified policy calls for publication in MECHANICAL ENGINEERING upon receipt of notification of death of each member, his name and essential biographical data in Who's Who form. For Honorary Members, Past-Presidents, and other distinguished members the death is noted in the minutes of the Executive Committee of the Council, special tribute or obituary appears in MECHANICAL ENGINEERING, a letter is sent to member of the immediate family, flowers are sent, and an honorary vice-president is appointed to represent the Council at the funeral. Names of members who died in a current Society year will be put in the record at the Annual Business Meeting. Memorial biographies for binding into the annual volume of Transactions will be discontinued with the issue now in preparation.

Smoke Regulation Ordinance

Upon recommendation of the Board on Codes and Standards it was voted to authorize publication of "Example Sections for Smoke Regulation Ordinance" prepared by the Smoke Law Committee of the Fuels Division for sale by the Society. The President was also authorized to appoint a committee of three to recommend development and modification of antipollution regulations.

Research Committee

Upon recommendation of the Research Committee the following research agreements were approved:

(1) Co-operative agreement between the Department of Interior for the U. S. Bureau of Mines and the ASME covering investigation of ash and slag in boiler furnaces, and the external corrosion of furnace wall tubes; the work to be carried out at the Central Experiment Station at the U. S. Bureau of Mines, Pittsburgh, Pa.

(2) Extension of agreement with the Ohio State University Research Foundation covering an investigation to determine coefficients of discharge of eccentric and segmental orifices.

(3) Agreement between the ASME and the Westinghouse Electric Corporation covering an experimental investigation of "Sliding Friction Under Extreme Pressures and at High Temperatures."

Sections

Upon recommendation of the Vice-Presidents the following changes in the organization of Sections were authorized: (1) Establishment of the Chattanooga Section to include certain counties in Tennessee, Georgia, and Alabama; (2) establishment of the Westmoreland Subsection of the Pittsburgh Section; (3) renaming of the Colorado Section as the Rocky Mountain Section and extending its boundaries to include the states of Wyoming and New Mexico; and (4) changing the name of the Piedmont-North Carolina Section to the Piedmont Section.

Wallace Clark Memorial

Upon recommendation of the Management Division, ASME participation in the Wallace Clark Memorial was approved. Appointment of David B. Porter as ASME representative on the Memorial Committee was also approved. Organizations participating in the Memorial are the American Management Association, Society for Advancement of Management, and other organizations with which the late Mr. Clark was associated. It is proposed to award a Wallace Clark Medal annually.

New Student Branches

Letter-ballot approval of establishment of student branches at the following institutions was noted for the record: (1) University of South Carolina; (2) Louisiana Polytechnic Institute; (3) University of Denver; and (4) Fenn College.

Certificates of Award

Upon recommendation of the Boiler Code Committee, Certificates of Award were approved for David S. Jacobus and C. A. Adams, retiring members of the Boiler Code Committee.

Certificates of Award granted to the following retiring chairmen were reported: T. H. Wickenden, Board on Membership; Frank W. Miller, Constitution and By-Laws Committee;

Frank H. Prouty, Engineers Registration Committee; Paul W. Thompson, Meetings Committee; J. J. Zeitner, Safety Committee; Ernest H. Hanhart, Baltimore Section; Herbert S. Malany, Cincinnati Section; F. O. Gibbs, Raleigh Section; and E. H. Throckmorton, Tri-Cities Section.

Engineers Joint Council

In accordance with the new EJC constitution calling for each constituent society to be represented by its two most recent available past-presidents, the ASME will be represented by Past-Presidents E. G. Bailey and E. W. O'Brien. Upon recommendation of President Todd and Past-Presidents Bailey and O'Brien, R. M. Gates was designated the Society's official alternate on EJC.

ASME Participation

The Committee approved ASME participation in the U. S. National Committee on Theoretical and Applied Mechanics which is being organized to promote theoretical and applied mechanics in the United States, and to represent the nation in the International Union of Theoretical and Applied Mechanics, also to serve as an agency of the Union in the United States. Appointment of Howard W. Emmons as ASME representative on the National Committee was approved.

Appointments

Letter-ballot approval of the following appointments was noted: Junior Committee: J. B. Burkhardt and F. Everett Reed, Jr. Publications Committee: George R. Rich; junior advisers, James M. Langley and Harold G. Wenig. Meetings Committee: R. E. Peterson; junior advisers, H. J. Scagnelli and Robert C. Spencer. Engineers Registration Committee: Marshall E. Farris.

Publications Problems Dominate 1949 Regional Administrative Committee Meetings

BETWEEN March 22 and April 23, 1949, all Sections of The American Society of Mechanical Engineers will send delegates to eight Regional Administrative Committee Meetings, one in each of the ASME Regions, to discuss suggested changes to ASME administrative practices.

The meetings, held in the spring of each year, are part of the machinery by which the individual member through the officers of his Section can have his say about how the Society conducts its activities. The schedule of the meetings is shown elsewhere on this page.

This year the Regional Administrative Committee Meetings will consider an agenda of 18 items pertaining to such topics as publications, membership development, professional status of the engineer, and Section activities.

Nine Publications Items

According to the 1949 agenda just released, publications matters will dominate the attention of Section and Regional delegates. Reflecting 12-months' experience with the new publications plan, nine suggestions have been submitted by the Sections calling for such modifications as cutting by one half the price of monthly publications to junior members under 30; more frequent issues of the cumulative indexes to ASME publications; more extensive digests of papers; granting of a limited number of free preprints each month to members; and distribution of free preprints at technical sessions.

Under membership development, the agenda lists five items designed to stimulate membership development and to enhance the membership grade. One of the items suggests that "the qualifications for the grade of member shall include a recognized professional engineer license."

On the subject of professional status of the engineer, two Sections suggested that the Society take official action to recommend that ASME members support and, if qualified, join the National Society of Professional Engineers.

One Section asked for more publicity in Society publications stressing advantages of taking the examination for the professional engineer license.

Under Section activities, one item suggested that a junior member from each section be sent to the Annual Meeting as a delegate with a part of his expenses paid by the Society.

All Sections Participate

In the fall of each year the ASME Agenda Committee of the Regional Delegates Conference invites each Section to suggest topics for discussion for the next Conference. These items are tabulated by the Agenda Committee and sent to each of the ASME Sections for approval. Items approved by 15 or more Sections are placed on the final agenda for consideration by the Regional Administrative Committtees and later by the Regional Delegates Conference. Two delegates of each Section attend the Regional Administrative Committee Meetings, at which two delegates from each Region are selected to carry the actions of the Committee to the Regional Delegates Conference held prior to the Semi-Annual Meeting. Final actions of the Conference are then referred to the Council for final disposition.

Section Activities

REPORTS of the following ASME Section Meetings were received recently at Headquarters:

Birmingham, Jan. 17. Speaker: D. Allshouse, Northern Equipment Co. Attendance: 50.

Boston, Jan. 27. Speaker: M. C. Hemsworth, General Electric Co. Attendance: 181.

Chattanooga, Jan. 21. Speaker: D. Allshouse, Northern Equipment Co. Attendance: 65.

Central Indiana, Jan. 21. Speaker: F. A. Ryder, chief engineer, South Wind Division, Stewart-Warner Corp., Indianapolis, Ind. Attendance: 122.

Colorado, Jan. 14. Speaker: E. B. Moses, Granby Pumping Plant, Colorado-Big Thomason Project. Attendance: 25.

Dayton, Jan. 19. Speaker: G. Nelson, head of research-engineering dept., National Cash Register Co. Attendance: 140.

East Tennessee (Oak Ridge Group), Jan. 19. Speaker: D. Allshouse, Northern Equipment Co. Attendance: 44.

Green Mountain, Jan. 28. Dinner meeting, guided tour, and film arranged by Cone Automatic Machine Co., Windsor, Vt. Speaker: F. M. Gunby, vice-president, ASME Region I

1949 Regional Administrative Committee Meetings

Region	*City*	*Hotel*	*Dates*
I	Hanover, N. H.	Hanover Inn	April 8–9
II	New York, N. Y.	ASME Headquarters	March 22–23
III	Lancaster, Pa.	Brunswick	March 31–Apr 1
IV	Birmingham, Ala.	Thomas Jefferson	April 3–5
V	Cincinnati, Ohio	Gibson	April 4–5
VI	Fort Wayne, Ind.	Van Orman	March 28–29
VII	Seattle, Wash.	Olympic	April 15–16
VIII	Houston, Tex.	Rice	April 22–23

and associate, Charles T. Main, Inc., Boston, Mass. Attendance: 100.

Hartford, Jan. 18. Speaker: A. L. MacClain. Attendance: 85.

Kansas City, Jan. 10. Speaker: F. A. Faville, chairman, ASME Engineers Civic Responsibility Committee. Attendance: 40.

Milwaukee, Jan. 12. Speaker: W. D. Anderson, Norma-Hoffmann Bearing Co. Attendance: 60.

Nebraska, Jan. 11. Joint meeting with University of Nebraska student branch. Speaker: F. Nagler, vice-president, ASME Region VI. Attendance: 168.

Jan. 12. Joint meeting with Engineers Club of Omaha. Speaker: F. Nagler, vice-president, ASME Region VI. Attendance: 74.

New Orleans, Dec. 17. Dinner dance in honor of J. M. Todd, president, ASME. Attendance: 50 members and their wives.

North Texas, Jan. 5. Speaker: W. W. Finlay. Attendance: 22.

Oregon, Dec. 20. Tour of the new *Oregon Journal* publishing plant. Evening program: Presentation of colored slides showing scenic views of Pacific Northwest. Speaker: M. P. Atkins, architect, Portland, Ore. Attendance: 35.

Philadelphia, Jan. 25. Speaker: W. F. Ryan. Attendance: 169.

Rochester, Jan. 13. Speaker: Prof. Paul B. Eaton, vice-president, ASME. Region III. Attendance: 132.

Rock River Valley, Jan. 20. Speaker: C. Asperheim. Attendance: 36.

San Francisco, Dec. 2. Speaker: Prof. A. L. London. Mem. ASME. Attendance: 170.

Dec. 16. Speaker: F. E. Russel, Jr. Attendance: 54.

Savannah, Jan. 22. Social Meeting. Attendance: 40.

South Texas, Jan. 21. Dinner meeting. Speakers: H. B. Wallace, manager of steam sales, Foster Wheeler Corp., New York, N. Y., and J. W. Cartinhour, assistant to director of engineering, also of Foster Wheeler. Attendance: 190.

South Texas (Junior Group), Jan. 14. Plant trip: Hughes Tool Co. plant, Houston, Texas. Attendance: 30.

Southern Tier, Jan. 24. Speaker: J. H. Thomas, N. Y. Department of Public Works. Attendance: 30.

Susquehanna, Jan. 25. Joint meeting of eight engineering societies and University Club of York. Speaker: J. M. Todd, president, ASME. Attendance: 150.

Tri-Cities, Nov. 23. Dinner meeting. Speaker: D. P. Barnard, research co-ordinator, Standard Oil Co. of Ind. Attendance: 17.

Jan. 25. Speaker: F. Nagler, vice-president, ASME, Region VI; chief mechanical engineer, Allis-Chalmers Manufacturing Co. Attendance: 106.

Wilmington, Jan. 19. Speaker: R. G. Dexter. Attendance: 95.

Worcester, Jan. 6. Speaker: F. G. Bishop. Attendance: 85.

Youngstown, Jan. 13. Speaker: A. L. Barrett, Joy Manufacturing Co., Pittsburgh, Pa. Attendance: 56.

Student Branch Activities

Reports of the following ASME student branch meetings were received recently at Headquarters:

Alabama Polytechnic Institute, Jan. 10. General business meeting. Attendance: 93.

Jan. 24. Business meeting. Film: Unfinished Business, produced by the U. S. Steel Corp. Attendance: 64.

Cooper Union (Day), Dec. 14. Twenty-fifth annual Christmas dinner. Attendance: 110.

Jan. 4. Film: Steam for Power. Attendance: 39.

Colorado A and M College, Jan. 19. Business meeting and films. Attendance: 85.

Cornell University, Jan. 13. U. S. Bureau of Mines' films. Attendance: 75.

Duke University, Jan. 11. General meeting and film. Attendance: 22.

University of Florida, Jan. 11. Speaker: Dr. Morgan, director of the University's engineering and industrial experiment station. Attendance: 34.

George Washington University. Speaker: F. G. Tatnall. Attendance: 120.

Georgia Institute of Technology, Jan. 18. Speaker: L. Zsuffa, chairman, Committee on Student Branches, ASME Region IV. Attendance: 112.

Jan. 25. Speaker: W. Tidmore, Smoke Abatement Committee, Atlanta, Ga. Attendance: 108.

Illinois Institute of Technology, Jan. 4. Election of officers for spring term. Attendance: 60.

Iowa State College. Speaker: G. Mast, Mast Development Co., Davenport, Iowa. Attendance: 130.

State University of Iowa, Dec. 15. Films. Speaker: J. Poulter.

Jan. 5. Speaker: Professor Croft.

Jan. 12. Speaker: E. Full, co-owner, KXIC radio station. Attendance: 103.

Jan. 19. General business meeting. Speaker: C. DeHaven.

University of Kentucky, Dec. 16. University Choristers in a program of Christmas carols.

Lafayette College, Jan. 20. Speaker: J. Fairhurst, Ingersoll-Rand Co., Phillipsburg, N. J. Attendance: 58.

University of Maine, Jan. 18. Film: Steam for Power. Attendance: 40.

Marquette University, Jan. 6. General business meeting. Attendance: 40.

Jan. 20. Film: Unfinished Business, produced by U. S. Steel Corp. Attendance: 135.

Michigan College of Mining and Technology, Jan. 11. Business meeting. Attendance: 75.

Jan. 18. Speaker: H. Garland, Forest Products Research Division, Michigan College of M&T. Attendance: 50.

University of Michigan, Jan. 12. Speakers: R. F. Hanson, chairman, ASME Detroit Section, and D. E. Jahncke, national chairman of ASME Junior Committee. Attendance: 50.

University of Minnesota, Jan. 12. Two films, one on papermaking and the other on problems of drilling for oil. Attendance: 180.

Jan. 26. General business meeting. Four members entered a contest to determine the winning speaker of the evening and candidate to represent the group at the regional convention as speaker. Attendance: 47.

1949 ASME Regional Student Branch Conferences

	Region	*Host*	*Place*	*Date*
I	New England	University of Connecticut	Storrs, Conn.	April 29–30
II	Eastern	Polytechnic Institute of Brooklyn	Brooklyn, N. Y.	April 30
III	Alleghenies	George Washington University	Washington, D. C.	April 1–2
IV	Southern	University of Alabama, Alabama Polytechnic Institute	Thomas Jefferson Hotel Birmingham, Ala.	April 4–5*
V	Midwest	Ohio State University	Columbus, Ohio	April 25–26
VI	Northern Tier	Marquette University	Milwaukee, Wis.	(Open)
VI	Southern Tier	Washington University	St. Louis, Mo.	(Open)
VII	Pacific N. W.	University of Washington	Seattle, Wash.	April 15–16
VII	Pacific S. W.	University of Nevada	Reno, Nevada	(Open)
VIII	Northern	University of Kansas	Lawrence, Kansas	(Open)
VIII	Southern	Texas Technological College	Lubbock, Texas	April 1–2
VIII	Rocky Mountain	Colorado School of Mines, New Mexico College of A & MA, University of Denver	Denver, Colorado	(Open)

* (Concurrent with Region IV Administrative Committee Meeting)

Mississippi State College, Jan. 6. Film on continuous rolling of steel. Attendance: 33.

Missouri School of Mines and Metallurgy, Jan. 18. Speaker: J. M. Kane, American Air Filter Co., Louisville, Ky. Attendance: 35.

University of Nebraska, Dec. 15. Joint meeting with ASME Nebraska Section and Lincoln Engineers Club. Speaker: Otto de Lorenzi, director of education, Combustion Engineering Corp. Attendance: 105.

Jan. 11. Speaker: F. Nagler, vice-president, ASME Region VI, chief mechanical engineer, Allis-Chalmers Manufacturing Co. Attendance: 146.

University of Nevada, Jan. 5. Showing of film on steam power. Attendance: 23.

New Mexico State College of A and M Arts, Jan. 6. Speakers: R. P. Forrest, E. W. Marsh, and C. Q. Ford. Attendance: 25.

Jan. 21. Business meeting. Speakers: P. Herlin, B. Edwards, B. Burdick, H. Logan, and J. Hardgrave, assistant in ME. Attendance: 40.

Northwestern University, Jan. 11. Business meeting. Film: The Development of the Sikorsky Helicopter. Attendance: 60.

Jan. 18. Demonstration lecture and film. Speaker: E. E. Braun, plant manager, Central Foundry Division, General Motors Corp., Danville Plant, Danville, Ill., assisted by D. S. Martin, production manager, Danville Plant. Attendance: 90.

Jan. 25. Business meeting. Film.

Ohio State University, Nov. 4. General business meeting. Robert Dine, instructor, mechanical-engineering department, elected honorary chairman. Attendance: 126.

Nov. 18. Speaker: Ralph Boyer. Attendance: 90.

Jan. 13. First meeting of winter quarter; election of officers. Attendance: 85.

Jan. 27. Business meeting. Speaker: W. Reed, research engineer, Battelle Memorial Institute. Attendance: 53.

Oklahoma A and M College, Jan. 10. Election of officers. Attendance: 45.

University of Oklahoma. Election of officers for spring semester. Attendance: 25.

Polytechnic Institute of Brooklyn (Evening), Dec. 14. Speaker: H. C. R. Carlson, consultant. Attendance: 45.

Jan. 10. Technical film: Melting, Smelting, and Refining of Copper. Speaker: I. T. Hook, design engineer, American Brass Co. Attendance: 26.

Purdue University, Jan. 18. Speaker: W. H. Sisson, Brown Instrument Division, Minneapolis-Honeywell Regulator Co. Attendance: 146.

Rice Institute, Jan. 10. Inspection trip to Sheffield Steel Co. plant near Houston. Evening of same day: election of officers for spring semester. Attendance: 46.

University of Rochester, Jan. 12. Speaker: Prof. P. B. Eaton, vice-president, ASME Region III. Attendance: 20.

Southern Methodist University, Jan. 11. Election of new officers. Attendance: 10.

University of Tennessee, Jan. 12. Speaker: D. M. Nickolas, plant superintendent. Attendance: 67.

Tufts College, Jan. 5. Speakers: Joseph Stoddard and Robert Whitfield, both of Barkley & Dexter Co. Attendance: 40.

Wayne University, Jan. 16. Speaker: J. Geschelin, editor, *Automotive Industries*, *Commercial Car*, and *Motor Age*. Attendance: 45.

University of Wisconsin, Jan. 11. Business meeting and showing of film Steam for Power. Attendance: 70.

Yale University, Jan. 19. Speaker: T. A. Boyd, co-developer of ethyl and consultant to General Motors Corp. Attendance: 48.

ASME Sections

Coming Meetings

Akron-Canton: March 24. Junior meeting in conjunction with Smoker. Subject: To be announced. Speaker to be announced.

Anthracite-Lehigh Valley: March 25. Reading Meeting. Subject: Marketing of Packaged Steam Generators. Speaker to be announced.

Atlanta: March 14. Georgia Engineering Society, Luncheon Meeting, YMCA Dining Room, 12:30 p.m. Subject: Aluminum, by G. Perkins, Reynolds Metal Co.

Boston: March 24. Section Meeting. Subject: Internal Combustion Engines, by Prof. C. F. Taylor, M.I.T.

Cincinnati: March 3. Joint Meeting. Student Night. University of Cincinnati, University of Dayton, and Ohio University.

Central Indiana: March 18. Hotel Francis, Kokomo, Ind. 6:30 p.m. Subject: Activities of the Kokomo Civic Planning Committee, by D. M. Snider, development engineer, Delco Radio Division, General Motors Corp.; Development and Uses of Corrosion and High-Temperature Alloys, by R. L. Lerch, vice-president, Haynes Stellite Co., Kokomo, Ind.

Hartford: March 15. City Club at 6:30 p.m. Subject: Some Mechanical Design Aspects in Electronic Devices, by R. E. Mathes, chief engineer, Gray Research and Development Co., Inc. Guest of honor, Richard K. Blackburn, technical director, WTHT.

Kansas City: March 14. University Club. Dinner at 6:30 p.m., meeting at 8 p.m. Subject: New jet-propulsion plant which Westinghouse Manufacturing Co. will soon start ni Kansas City. Speaker: An official of Westinghouse Manufacturing Co. to be announced.

Metropolitan: March 8. Applied Mechanics-Heat Transfer Division, Room 502[1] at 7:15 p.m. Subject: New Uses for Audible and Inaudible Sound Waves in Science and Industry, by Asst. Prof. E. P. Neumann, M.I.T., and director of engineering, Ultrasonic Corp., Prof. H. K. Schilling, head of department of physics, Penn State College, H. W. St. Clair, metallurgist, U. S. Bureau of Mines, and Prof. R. H. Wallace, University of Connecticut. Discussers: C. B. Horsley, president, Sonic Research Corp., G. E. Pray, president, Radio Sonic Corp., J. C. Smack, engineer, Sperry Products, Inc.

March 10. Woman's Auxiliary, Engineering Woman's Club, 2 Fifth Avenue, New York, N. Y., at 12:30 p.m. Annual Card Party and Luncheon, benefit of the Calvin Rice Scholarship and Student Loan Fund, price $2.50.

[1] Engineering Societies Building, New York, N. Y.

March 15. Materials Handling Forum, Room 1101[1] at 7:30 p.m.

March 22. General Interest Meeting, Room 501[1] at 7:30 p.m. Subject: Engineering Progress—by Inches and Miles, by C. A. Scarlott, manager, Westinghouse Publications.

March 22 and 23. Regional Administrative Committee Meeting, Region II, Room 1101[1] at 7 p.m.

March 31. Engineers Forum, Room 1101[1] at 7:30 p.m. Subject: Our City of Cities.

Minnesota: March 2. Section Meeting. Subject: Talk on the American free enterprise system. Speaker to be announced.

New Orleans: March (no date). Section will visit Baton Rouge, La., for a meeting sponsored by ASME members in that city.

Ontario: March 10. Music Room, Hart House at 8 p.m. Subject: The Labrador Ore Fields, by Dr. J. A. Retty, chief metallurgist, Labrador Mining and Exploration Co.

Peninsula: March 8. Auditorium of the Grand Rapids Public Museum at 8 p.m. Subject: Atomic energy, by Dr. Osgood, University of Michigan.

Philadelphia: March 9. Engineers' Club of Philadelphia. Student Night.

March 15. Professional Division Meeting. Towne School, University of Pennsylvania. Subject: Impregnated Materials for Use by the Engineer. Panel discussion sponsored by Dr. T. Hetzel, Haverford College.

March 22. Joint Meeting with SNAME. Engineers' Club. Subject: Combustion of Fuels in Boilers, by Otto de Lorenzi, director of education, Combustion Engineering Corp.

Plainfield: March 16. Elk's Club, Elizabeth, N. J. at 8:15 p.m. Subject: Color in Industry, by Dr. S. G. Hibben, Laboratory Division, Westinghouse Electric Corp., Bloomfield, N. J.

March 22. Rutgers University, New Brunswick, N. J. at 8:15 p.m. Joint Meeting with the AIEE (Metropolitan Section). Subject: Variable Speed Drives, by R. L. McAll, American Blower Co. (ASME speaker). Subject: Couplings, by L. F. Stoner, General Electric Co., Newark, New Jersey, Branch (AIEE speaker).

St. Louis: March 25. Section Meeting. Subject: Steam Boilers, by F. Gilg, Babcock and Wilcox Co.

San Diego Subsection: March 16. San Diego Women's Club. Dinner. Subject: Atomic Energy, by L. M. Klauber, president, San Diego Gas and Electric Co.

March 30. Inspection trip, The San Diego Telephone Co. "Hillcrest Automatic Exchange" and mobile operation.

Southern California: March 2. Hydraulic Division. California Institute of Technology, Mechanical Engineering Building, Pasadena. Subject: Pump Design and Testing, by Prof. A. Hollander.

March 2. Management Division. Southern California Edison Building, Room 214, 601 West 5th Street, Los Angeles. Subject: Organization, by E. Favary.

March 2. Industrial Engineering Division. Southern California Edison Building, Room 215, 601 West 5th Street, Los Angeles. Subject: 1949 Activities, by J. L. Anderson.

March 9. Hydraulic Division. California Institute of Technology, Mechanical Engineer-

ing Building, Pasadena. Subject: Pump Design, by P. H. Brown.

March 9. Instruments and Regulators Division. Southern California Gas Co. Auditorium, Los Angeles. Subject: Automatic Controls, by S. G. Eskin.

March 16. Hydraulic Division. California Institute of Technology, Mechanical Engineering Building, Pasadena. Subject: Piping Design, by L. Vance.

March 21. Photographic Division. Pacific University Products, Pasadena. Subject: High-Vacuum Evaporation, by R. E. Frazer.

March 23. Management Division. Southern California Edison Building, Room 214, 601 West 5th Street, Los Angeles. Subject: Management Problems, by E. Favary.

March 23. Hydraulic Division. California Institute of Technology, Mechanical Engineering Building, Pasadena. Subject: Control Systems, by J. Newton.

March 26. Steam Power Division. Field trip. Pacific Gas and Electric Co., Kern Station Plant, Bakersfield.

March 30. Hydraulic Division. California Institute of Technology, Mechanical Engineering Building, Pasadena. Subject: Hydroelectric Design, by W. Cates.

Southern Tier: March 24. Section Meeting. Subject: Gas Turbines. Speaker to be announced.

Syracuse: March 21. Joint Meeting with affiliated societies. Subject: The Engineer in China, by Prof. P. B. Eaton, vice-president ASME Region III, and head of the mechanical engineering department, Lafayette College, Easton, Pa.

Youngstown: March 24. Professional Divisions Meeting. Basic Sciences (Applied Mechanics, Hydraulics, Heat Transfer, Machine Design). Speaker and subject to be announced.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the natiønl societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3.50 per quarter or $12 per annum, payable in advance.

New York 8 West 40th St. | **Chicago** 84 East Randolph Street | **Detroit** 100 Farnsworth Ave. | **San Francisco** 57 Post Street

MEN AVAILABLE[1]

PRODUCTION ENGINEER, mechanical, young, experienced in process development, methods engineering, cost reduction, plant layout, and tool design in metal working industries. Desires responsible position with small progressive company. Me-378-17-M.

MECHANICAL ENGINEER, readily adaptable to all industrial problems. Has experience managing, single-handed, a small manufacturing business. Young and energetic. Stevens graduate. New Jersey, eastern Pennsylvania. Me-379.

MECHANICAL ENGINEER, 39, married; Pa. State license. Experienced in excavating machinery and power shovels, steelmaking in electric furnaces, powerhouse steam generation. Mideastern States. Me-380.

INDUSTRIAL ENGINEER, BSIE, MS candidate, 28, married. Experienced all phases production control, job-lot metal fabrication. Systems and procedures, standard-practice instructions, bottleshop layouts, customer correspondence. Top record on results. Me-381.

THEORETICAL ENGINEER, physics MS, mathematics SM, six years' experience in analysis, design, writing, planning; desires administrative nonsupervisory position requiring broad knowledge and varied duties in organization having only nonmilitary contracts. Me-382.

MECHANICAL ENGINEER, 28, BS. Three years' diversified employment as a student engineer. Three years in navy steam power plant as senior watch officer. In charge of maintenance, Diesel, and evaporating units. Three years as assistant professor of heat, power, and fluid flow. Had lead in heat, power, and fluid courses. Me-383.

INDUSTRIAL ENGINEER, 30, married. Two years plant engineer large chemical-processing plant, two years utilities, job evaluation, materials handling, maintenance, safety. Wide administrative experience. Changing for more opportunity. South. Me-384.

MECHANICAL ENGINEER, 27, BS University of Colorado. Machine-shop background and three years' experience in research, test, and development with top-notch laboratories. New York-Metropolitan area. Me-385.

PLANT OR MAINTENANCE ENGINEER, BME, 36. Licensed professional, stationary, refrigerating, and marine engineer. Skilled maintenance mechanic and electrician as well as able supervisor. New York-Metropolitan area preferred, but will go out of town. Me-386.

ADMINISTRATIVE ASSISTANT OR INDUSTRIAL ENGINEER, 23, BS aeronautical engineering, BSME 1945, MS Management, Feb. 1950. One year experience as administrative assistant in charge of engineering planning and control. Two years as mechanical engineer, including design work, test programs, progress-report writing, etc. Me-387.

POWER ENGINEER, 23, single, BSME, Tufts; three years' experience design, installation, operation of industrial and naval boiler plants and related industrial instrumentation. Northeast. Available immediately. Me-388.

[1] All men listed hold some form of ASME membership.

POSITIONS AVAILABLE

INSTRUMENT SALES ENGINEERS, 25-40, with BS degree in electrical engineering or physics. Salary and expenses. Territories, East and Midwest. Y-1924.

BUYER, mechanical graduate with some experience in purchasing, for work involving the buying of metals and miscellaneous production supplies. $3600-$4200 depending on qualifications. Ohio. Y-1990-D.

SENIOR MECHANICAL ENGINEER, graduate, with five years' experience in some process industry, such as food, chemical, oils, plastics, etc. Will create assignments, follow up and co-ordinate activities of engineers in the development and fulfillment of any project of the department from the design stage to finished installation. Special duties will include development of plant layout and analyze and work out the solution for problems in other fields of mechanical engineering, such as power, electrical, and process equipment. Will also work with outside firms, contractors, suppliers, and consultants in special problems upon assignment. $5000-$6000. Pittsburgh, Pa. Y-1996.

POWER SUPERINTENDENT, 35-45, mechanical graduate, with at least ten years' power-plant operating experience, to supervise improvements of present steam-power plant, steam-distribution system for paper mill. $6000-$8000. New Jersey. Y-2003.

MECHANICAL ENGINEER, experienced in combustion, with knowledge of power-plant design and operation of coal-sales engineering work. Maryland. Y-2004.

MINING ENGINEER for an asbestos mine, 26-30, graduate, with three to five years' experience in open-quarry and underground-mining operations and engineering work. Asbestos experience not essential. Will act as assistant quarry superintendent and do necessary mining-engineering work, especially in application of better mining methods. $4200-$5400 depending on experience, with opportunities for advancement. Vermont. Y-2011.

PROJECT ENGINEER, mechanical graduate, with studies in optics; or physicist with studies in mechanics and optics. Should have five to ten years' experience in design and de-

(*ASME News continued on page 286*)

velopment of precision instruments involving optics. Must be capable of laying out optical paths and designing the related mechanical parts. Should have thorough knowledge of the principles and mathematics of optics so that problems can be analyzed and solved. Will be responsible for the design, development, and test of subsidiary optics and related mechanical parts for a tracking instrument. Projects will include work on aerial cameras, photogrammetry, camera accessories, and instruments involving optics. $7200. New York metropolitan area. Y-2013.

Tool and Die Designer with at least fifteen years' experience covering tool and die design and shop operations, to design tools and compound progressive dies for novelty manufacturer. $8000. Northern New Jersey. Y-2024.

Metallurgist, 30-35, preferably with a master's degree, with five to ten years' experience in steelmaking and/or smelting of nonferrous metals. Will act as consultant for central engineering department for large manufacturer. $5000-$6000. Connecticut. Y-2029.

Mechanical Engineer, 35-45, with several years' experience in public-utility work, particularly on high temperature, high pressure, and in addition some turbine work. To $7500. Ohio. Y-2030(a)D.

Mechanical Engineer for design and application of process machinery and selection of it for specific applications. Machinery or equipment consists of liquid mixers, dry mixers, ball mills, pebble mills; also heavy-duty industrial fans and blowers. Duties will also involve directing of sales office. $6500-$7500. Southwestern Ohio. Y-2046(a)D.

Chief Engineer with five to ten years' experience in paper and pulp. Will have complete technical control of the operation of a number of paper and pulp plants in New England and Canada. $15,000-$18,000. Headquarters, New York, N. Y. Y-2065.

Personnel Director, 30-40, with at least ten years' industrial manufacturing experience, to supervise records, mili-training program, upgrading, community relations, company magazine, etc., for textile manufacturer. Salary $6000-$8000. Pennsylvania. Y-2099.

Sales Engineer, mechanical graduate, 30-35, with construction-materials experience, to call on architects, engineers, contractors, and manufacturers regarding rock products and accessories. $4800. Ohio. Y-2107-C-D.

Mechanical Engineer, graduate, with several years' experience in power-plant layout, process piping, and hydraulics for consultant's office located in Ohio. State qualifications, experience, age, starting salary, and date available. Salary open. Ohio. D-4666.

Candidates for Membership and Transfer in the ASME

The application of each of the candidates listed below is to be voted on after March 25, 1949, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

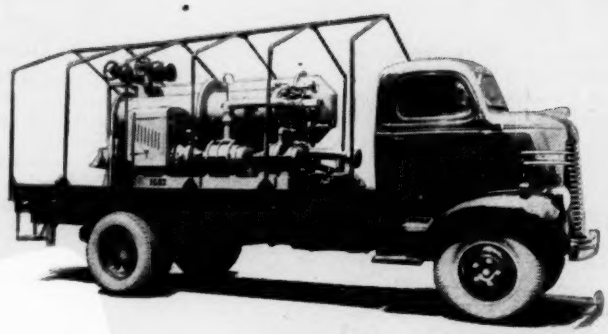
NEW APPLICATIONS

For Member, Associate, or Junior

Anderson, John Gilbert, Detroit, Mich.
Astrove, Edgar, Bronx, N. Y.
Beyerle, William P., Linthicum Heights, Md.
Boggs, H. E., Amarillo, Texas
Borecki, Theodore B., Brooklyn, N. Y.
Brown, Gordon P., Cassadaga, N. Y.
Burke, Francis L., Newark, N. J.
Burner, Albert F., Arlington, Va.
Cagnoni, Guido J., Kenvil, N. J. (Rt & T)
Carley, Harold James, Lockport, N. Y.
Carter, Ray E., Tulsa, Okla.
Carter, William J., Austin, Texas
Cartlidge, James Michael, Trenton, N. J.
Chenoweth, Dean B., Minneapolis, Minn.
Christensen, F. J., El Paso, Texas
Clark, H., Dallas, Texas
Cooper, Franklin Dixon, DeWitt, N. Y.
Corrigan, Robert E., Erie, Pa.
Covode, John H., Cincinnati, Ohio
Croxford-Adams, G. F., Northampton, England
Dahl, Conrad C., Detroit, Mich.
Dismukes, A. R., Pittsburgh, Pa. (Rt)
Dow, Willard M., Shreveport, La.
Doyal, John Prescott, Chattanooga, Tenn.
Dukes, W. W., Jr., Orangeburg, S. C.
Dunwoody, William B., Kansas City, Mo.
Elliott, Phil T., Rochester, N. Y.
Finnegan, W. J., Los Angeles, Calif.
Fleischauer, Fred J., Pittsburgh, Pa.
Flindt, Albert Otis, Ann Arbor, Mich.
Floyd, Samuel B., Jr., Pittsburgh, Pa.
Freyberg, Richard H., Jr., Pleasantville, L. I., N. Y.
Fuller, William W., Youngstown, Ohio
Funk, Rex R., Los Angeles, Calif.
Gabriele, Nicholas A., Bridgeport, Pa.
Giesler, Arthur E., Toledo, Ohio
Givens, George C., Allentown, Pa. (Rt & T)
Good, J. Allen, Detroit, Mich. (Rt & T)
Goos, Julius J., Oak Ridge, Tenn.
Goudielock, William B. O., Forest Hills, L. I., N. Y.
Greener, William B., St. Johns, Mich.
Gustavson, Andrew J., New York, N. Y.
Gustray, Albert Joseph, Philadelphia, Pa.
Habib, Edward T., Arlington, Va.
Hanel, H., Palos Heights, Ill.
Harrison, Benjamin F., Jr., Rossville, Ga.
Harrison, Robert E., Columbia, S. C.
Hays, Leroy D., New York, N. Y.
Heath, George L., Toledo, Ohio
Herbkersman, C., Cleveland, Ohio
Hoadley, David A., North Adams, Mass.
Holleron, William K., Houston, Texas
Iturralde, Manuel R., Astoria, L. I., N. Y.
Jewett, Charles L., Chestnut Hill, Mass.
Jones, Edwin H., Nazareth, Pa. (Rt)
Keiser, Robert Karl, Butler, Pa.
Klick, Maurice P., Los Angeles, Calif.
Knight, William R., Cincinnati, Ohio
Kogan, H. W., Brooklyn, N. Y.
Kramer, Edward L., Buffalo, N. Y.
Lang, Albert V., Cincinnati, Ohio
Lavender, Beverly Edward, Jersey City, N. J.
Leahy, Edward F., Perth Amboy, N. J.
Levine, Frederick Irwin, Paterson, N. J.
Leymaster, Ivan L., Arcadia, Calif.
Lindstrom, Rolf, Borås, Älvsborg, Sweden
Lonergan, John J., West Allis, Wis.
Lowry, Darwin P., Kansas City, Mo.
Lundsgaard, Warren L., Fargo, N. Dak.
Macrae, Lester F., Madison, N. J.
Malcolm, D. G., Berkeley, Calif.
Martel, Max Robert, East Moline, Ill.
McMillan, Donald D., Portland, Ore.
Moore, John H., Havertown, Pa.
Morton, Lloyd J., Cleveland, Ohio
Newkirk, Merle, Midland, Mich.
Orr, J. D., Toronto, Ontario, Can.
Paine, C. B., Jr., Long Beach, Calif.
Pool, Eldert Bergen, Riverside, Ill.
Potts, Roy E., Hammond, Ind.
Precious, Robert W., Pittsburgh, Pa.
Price, Glen A., Woodside, L. I., N. Y.
Rahe, William C., Toledo, Ohio
Ralli, Victor M., Claymont, Del.
Riggs, W. A., Mobile, Ala.
Ritchie, F. P., Oakland, Calif.
Ritterhoff, C. William, Baltimore, Md.
Roepcke, Fay A., Detroit, Mich.
Roop, Wendell R., Sewell Farm, N. J. (Rt)
Ross, Jack S., Vienna, Md.
Saunders, A. M., Pasadena, Calif.
Schoenborn, Edward M., Raleigh, N. C.
Schumann, Robert D., Altadena, Calif.
Schwalm, John M., Glenolden, Pa.
Scruggs, Herbert A., Kingsport, Tenn.
Shulock, Charles, Jeannette, Pa.
Sisson, Arthur H., Westminster, Mass.
Snow, Russell K., Tulsa, Okla.
Stevenson, George A., Parkersburg, W. Va. (Rt)
Stewart, James M., Jr., Lake Charles, La.
Streeter, Donald M., Jackson, Mich.
Sturges, John M., New York, N. Y.
Sutton, Jack P., Akron, Ohio
Swainger, K. H., London, England
Swanson, Carl Arvid, Youngstown, Ohio
Swanson, Ernest Allen, River Edge, N. J.
Talbert, Paul D., Claremont, N. H.
Thiene, Carl G., Pasadena, Calif.
Thoen, J. O., Ponca City, Okla.
Toelke, Lester W., Houston, Texas
Valdenazzi, L. J., Varazze, Liguria, Italy
Van Leer, Blake W., San Bruno, Calif.
Vieth, Edward L., Cincinnati, Ohio
Viets, Henry E., Long Beach, Calif.
Vironda, Louis, Los Angeles, Calif.
Warg, Clifford R., Dearborn, Mich.
Weaver, Ernest W., Jr., Toledo, Ohio
Weeks, C. L., Hermosa Beach, Calif.
Wikstrom, Olle, Borås, Älvsborg, Sweden
Wilder, Jesse H., Durham, N. C.

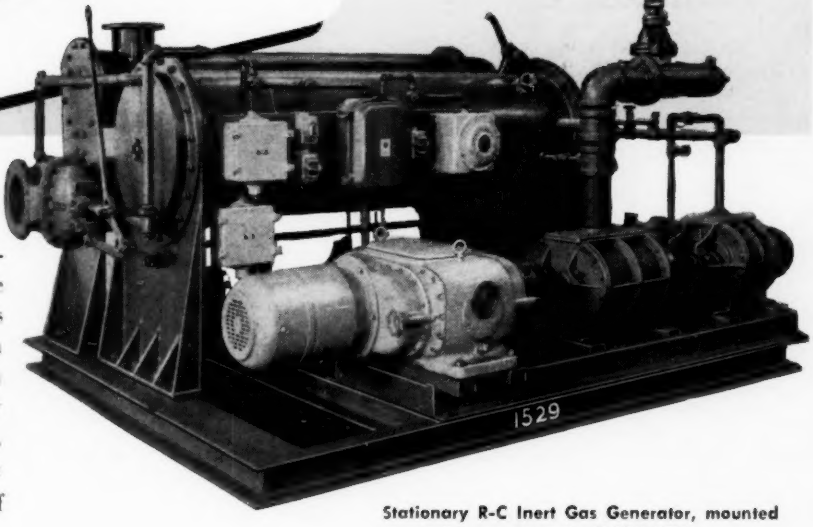
(*ASME News continued on page 288*)

FOR PORTABLE OR STATIONARY PROTECTION...



Portable R-C Inert Gas Generator, of 15,000 CFH capacity, mounted on pneumatic-tired truck

R-C Inert Gas Generators



Stationary R-C Inert Gas Generator, mounted on steel base. Capacity 3,000 CFH.

You can reduce the hazards of processing, handling or storing inflammable gases or liquids with R-C Inert Gas Generators. They produce cheaply a mixture of nitrogen and carbon dioxide, using oil or gas as fuel. They are built in fixed or portable units, with these outstanding advantages:

1. Large capacity in terms of weight and cost.
2. Low operating and maintenance cost.
3. Quick adjustments for complete combustion.
4. No adjustments, for same fuel, needed after shut-down.
5. Operation not affected by variation in back pressure.
6. Extremely quiet operation.

With capacities from 1,000 CFH to 50,000 CFH, R-C Inert Gas Generators provide quick, dependable protection, at low cost. They are equally efficient, also, for inert gas production for processing operations. Write for details in Bulletin 100-B-14.

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WILSON, J. C., Philadelphia, Pa.
WING, PAUL A., Pasadena, Calif.
WOOD, WILLIAM E., Swarthmore, Pa.
ZIRIN, LOUIS I., Boston, Mass.
ZITO, FREDERICK A., New York, N. Y.

CHANGE IN GRADING

Transfer to Member

ALCIATI, CHARLES J., San Francisco, Calif.
AMENS, HAROLD C., Salt Lake City, Utah
BAUMAN, WALLACE H., Aldan, Pa.
FOWLER, JACKSON E., Schenectady, N. Y.
GAGNON, ALFRED J., Honolulu, T. H.
HAMILL, T. M., Old Greenwich, Conn.
LEE, HENRY W. F., Niagara Falls, N. Y.
MCGUIRE, ERWIN J., Rochester, N. Y.
MILLER, ROBERT P., Columbus, Ohio
MORROW, COLE H., Racine, Wis.
NEWELL, T. A., Wilmington, Del.
PARSONS, R. L., La Habra, Calif.
REICHARD, HERMAN C., Kansas City, Mo.
SCHUM, EUGENE C., Hamilton, Ohio
SWEETLAND, E., Pasadena, Calif.
TEAL, F. MARTIN, Lockport, N. Y.
TRAMM, GILBERT E., Bradley, Ill.
WOOD, KENDALL M., Opportunity, Wash.
YARBER, GORDON W., Seattle, Wash.
YEAGER, WILLIS T., Cincinnati, Ohio
ZAVODNY, STEPHEN, Cheltenham, Pa.

Transfers from Student Member to Junior 323

Obituaries

George B. Brand (1870–1948)

GEORGE B. BRAND, consulting engineer, died at his home in Hollywood, Calif., on Dec. 19, 1948, following a long illness. Born, Ilion, N. Y., Jan. 16, 1870. Parents, Harrison and Marion S. (Eaton) Brand. Education, graduate, Ilion High School. Married Inez Trowbridge, 1902; children, Marion and Phoebe. Mem. ASME, 1912.

Albert Edmund Cluett (1872–1949)

ALBERT E. CLUETT, for many years associated with Cluett, Peabody and Co., Inc.; chairman of the board, Troy (N. Y.) Savings Bank, died Jan. 3, 1949, at his home in Troy, N. Y., after a long illness. Born, Troy, N. Y., Oct. 15, 1872. Parents, Edmund and Mary Alice (Stone) Cluett. Education, Albany Academy; AB, Williams College, 1893; BS, Massachusetts Institute of Technology, 1896. Jun. ASME, 1900; Mem. ASME, 1903; served on Nominating Committee, 1912. Former president, Society of Engineers of Eastern New York. Surviving are his widow, Caroline Ide Cluett, whom he married in 1904; four sons, John Girvin, Troy, N. Y., Edmund, Plymouth Meeting, Pa., Albert E., Jr., Des Moines, Iowa, and Richard Ide, Tuckahoe, N. Y.; and a brother, Sanford L. Cluett, Troy, N. Y.

Raymond Wilson Cook (1890–1948)

RAYMOND W. COOK, executive vice-president, Associated Spring Corp., Bristol, Conn., died at Hartford Hospital, Dec. 4, 1948. Born, Bristol, Conn., Aug. 16, 1890. Parents, Charles S. and Helen P. Cook. Education, graduate, Bristol (Conn.) High School. Married Florence Yale, 1915; four children. Mem. ASME, 1927; served on Research Committee on Mechanical Springs, 1932–1948.

John Henry Damon (1864–1948)

JOHN H. DAMON, retired plant engineer, Plymouth Cordage Co., North Plymouth, Mass., died in the fall of 1948. Born, Plymouth, Mass., July 5, 1864. Parents, Calvin Smith and Jerusha (Weston) Damon. Education, Plymouth High School; 2 years, Massachusetts Institute of Technology. Assoc. ASME, 1908; Mem. ASME, 1910.

James Lincoln Foord (1861–1948)

JAMES L. FOORD, retired in 1929, after 35 years with Hartford Steam Boiler Inspection and Insurance Co., Boston, Mass., died Nov. 13, 1948. Born, Geneva, N. Y., Aug. 17, 1861. Parents, Joseph and Sarah J. Foord. Education, public schools, Auburn, N. Y. Married L. E. Elder, April 23, 1886; child, James S. Foord. Mem. ASME, 1915.

Carl Herman Graesser (1883–1948)

CARL H. GRAESSER, vice-president in charge of engineering, Manning, Maxwell and Moore, Inc., Bridgeport, Conn., died Dec. 18, 1948, in his home at Southport, Conn. Born, Buffalo, N. Y., April 15, 1883. Parents, Charles F. and Julia (Roth) Graesser. Education, Buffalo Central High School, 1901; BS, Massachusetts Institute of Technology, 1905. Mem. ASME, 1938. Surviving are his wife, Mrs. Betty Werner Graesser; a son, Foster Graesser, New York, N. Y., and a daughter, Mrs. Barbara (Lewis E.) Scott, Orlando, Fla.

David Park Graham (1902–1948)

DAVID P. GRAHAM, vice-president, Peabody Engineering Corp., New York, N. Y., died of heart disease, Dec. 18, 1948, at his home in Westbury, L. I., N. Y. Born, Boston, Mass., Dec. 4, 1902. Parents, Thomas J. and Janet (Park) Graham. Education, East Orange (N. J.) High School; ME, Stevens Institute of Technology, 1923. Married Helen Mattson, 1928. Jun. ASME, 1924. Surviving are his wife; a son, David Murray, and three daughters, Janet Louise, Deborah Sue, and Dorothy Ann; and a sister, Mrs. C. J. Ulrich, New York, N. Y.

William Darrach Halsey (1890–1948)

WILLIAM D. HALSEY, chief engineer of the boiler division of the Hartford Steam Boiler Inspection and Insurance Company, died suddenly at his home in West Hartford, Conn., Dec. 9, 1948. Born, Philadelphia, Pa., Feb. 26, 1890. Parents, Frederick Woodbridge and Eleanor (Darrach) Halsey. Education, AB, Swarthmore College, 1912. Married Mary Flagg Price, 1917. Jun. ASME, 1916; Assoc. Mem. ASME, 1918; Mem. ASME, 1923. Served as secretary-treasurer, ASME Hartford Section, 1921–22; vice-chairman, ASME Hartford Section 1922–23; was chairman, from its inception to 1943, of the Special Research Committee on Strength of Vessels Under External Pressure and served on many of the Boiler Code committees. Surviving are his wife; two sons, William D., Jr., and James Price; and a daughter, Mary Jane Halsey.

Urquhart Archer Hammett (1900–1948)

U. A. HAMMETT, district sales manager of The Permutit Co., stationed in Los Angeles, Calif., died Jan. 19, 1948. Born, Leipsic, Ohio, July 30, 1900. Parents, Edward and Ann (Archer) Hammett. Education, graduate, Scott High School, Toledo, Ohio, 1916; Toledo University Extension Courses. Married Lydia Clark. Mem. ASME, 1937. Surviving are his wife; daughter, Mrs. Walter Delmar, Pacific Palisades, Calif.; and son, Donald, Pasadena, Calif.

Embury Asbury Hitchcock (1866–1948)

EMBURY A. HITCHCOCK, dean emeritus, College of Engineering, Ohio State University, died April 29, 1928. Born, Henrietta, N. Y., June 26, 1866. Parents, Julius Charles and Finett Rosett (Potter) Hitchcock. Education, ME, Cornell University, 1890. Married Isabel Mortimore 1896 (died 1933); children, Isabel M., E. Mortimore, Harriet H. Married 2d, Florence Estelle Mortimore, 1940. Mem. ASME, 1898.

Robert James Needham (1882–1948)

ROBERT J. NEEDHAM, retired mechanical and electrical engineer of the Central Region, Canadian National Railways, Toronto, Ont., Can., died Oct. 25, 1948. Born, London, Ont., Jan. 11, 1882. Parents, Charles Frederick and Caroline Needham. Education, BS, McGill University, 1910. Married Blanche Allen, 1916; children, Robert James, Jr., and Elizabeth Jean. Mem. ASME, 1920.

Joseph C. Regan (1872–1948)

JOSEPH C. REGAN, retired president and general manager, E. Horton and Son Co., Windsor Locks, Conn., died Nov. 18, 1948, in St. Francis Hospital, Hartford, Conn., following several months' illness. Born, Seymour, Conn., July 12, 1872. Education, Deep River High School; 3 years Columbia University. Mem. ASME, 1911. Survived by wife, Mrs. Mary (Degnan) Regan; three daughters, Norma K. and Alice D., all of Windsor Locks, Conn., and May A., Scarsdale, N. Y.; and a brother, Edward C. Regan, Hartford, Conn.

Edward Joseph Rigby (1859–1948)

EDWARD J. RIGBY, technical director, chairman, of the Robert Bryce and Co., Proprietary, Ltd., Melbourne, Victoria, Australia, died Oct. 24, 1948. Born, Melborne, Australia, Jan. 5, 1859. Education, Scotch College and private tuition in mechanics. Mem. ASME, 1918.

Karl Edward Stoll (1902–1949)

KARL E. STOLL, assistant chief engineer, Powerton Station of Commonwealth Edison Co., at Pekin, Ill., died of a cerebral hemorrhage, Jan. 2, 1949, at Pekin, Ill. Born, Connersville, Ind., July 27, 1902. Parents, John and Anne Marie (Disque) Stoll. Education, BSME, Purdue University, 1924. Married Marian Page, April 18, 1947. Mem. ASME, 1943. Survived by wife and two daughters, Mary Alice and Jo Anne.

Nikita Borisowich Strachovsky (1900–1948)

NIKITA B. STRACHOVSKY, research engineer, Carborundum Co., Niagara Falls, N. Y., died of a heart attack, Dec. 9, 1948, in New York, N. Y. Born, Sevastopol, Russia, Feb. 24, 1900. Parents, Borisowich and Xenia (Berg) Strachovsky. Education, Naval Corps of Cadets, 1915; Naval Academy, 1917; BS, Kings College, University of London (England), 1923; DS, Sorbonne University, Paris, France, 1928. Married Joan La Manita, April 10, 1941. Mem. ASME, 1946. Survived by wife; three daughters, Stephanie, Denise, Suzanne, and one son, Gregory.